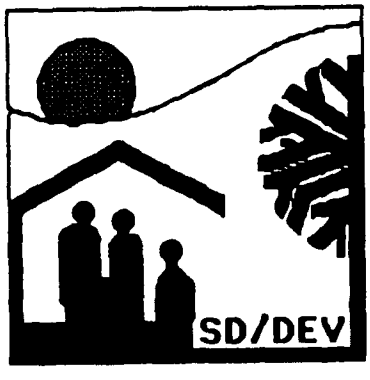
Environmental Impact Analysis Process



PRELIMINARY ENVIRONMENTAL
CONSTRAINTS SURVEY
U.S. AIR FORCE, SPACE DIVISION
ADVANCED LAUNCH SYSTEM (ALS)

SEPTEMBER 1988

DEPARTMENT OF THE AIR FORCE

Air Force
Environmental Planning Division
(HQ USAF/CEVP)

Room 5B269
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Washington, DC 20330-1260

16 JUL 93

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Environmental Impact Analysis Process

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1.0 EXECUTIVE SUMMARY

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1.1 INTRODUCTION

The U.S. space program is currently dependent on launch vehicles developed in the 1950's, 60's and 70's. These vehicles are used to insert payloads/cargo into a variety of orbits ranging from low earth orbits (LEO) to geosynchronous earth orbit (GEO). Easterly LEOs are primarily supported out of the eastern test range (ETR) and near-polar LEOs are primarily out of the western test range (WTR). Existing payload lift capacities of the current U.S. launch vehicles are from 500 to 65,000 pounds. However, future programs, including weather, communications and surveillance platforms, the Space Station program, and the Strategic Defense Initiative, have requirements for lift capability in excess of that available with the current launch vehicles.

The need to launch large payloads (65,000 to 190,000 pounds or greater) into easterly LEO, payloads in excess of 65,000 pounds into near-polar LEO, and payloads over 15,000 pounds into GEO within the relatively near future has resulted in a joint USAF and NASA program to develop an Advanced Launch System (ALS) which will meet the required lift capability. The general concept of the ALS is for a liquid-fueled (liquid oxygen [LO_2]/liquid hydrogen [LH_2]) core vehicle with "strap-on" boosters added to increase payload lift capability. Boosters being considered include expendable liquid fueled (LO_2/LH_2) boosters, recoverable "flyback" liquid boosters, and solid propellant rocket boosters (SRB).

Other elements of the ALS launch vehicle may also be reusable, including propulsion and avionics (P/A) modules containing engines, nozzles, and guidance and control equipment.

Under the Department of Defense (DOD) Major Systems Acquisition Process (MSAP) the Air Force Space Division has contracted for the development of ALS concepts. Five contractors, Boeing Company, General Dynamics Corporation, Martin Marietta Corporation/McDonnell Douglas (team concept), Rockwell International, and United Technologies Corporation have submitted candidate concepts for an ALS. The Space Division requires an evaluation of the potential environmental constraints related to each ALS concept.

This Preliminary Environmental Constraints Survey addresses two important elements. The first element is to identify the major environmental issues that may result in constraints to development of ALS or those issues which will need to be addressed in more detailed NEPA compliance documentation prior to full-scale development and deployment, and the second element is to evaluate the constraints compliance with the National Environmental Policy Act (NEPA) will place on the ALS program.

1.2 ENVIRONMENTAL CONSTRAINTS SURVEY

The environmental impact analysis process for the ALS will be phased. This document addresses the environmental constraints potentially affecting the ALS concepts. Specific environmental analyses will be conducted, as required for future program milestones, for those concepts carried forward.

The decision to reduce the number of candidate ALS concepts being carried forward to the demonstration and validation phase has been evaluated for potential impacts to geological, air, water, biological, noise, land use, visual, cultural, socioeconomic, health and safety, and hazardous waste concerns. The analysis of the potential impacts due to the narrowing decision indicates the decision will have no significant impacts on the environment. The impacts of the narrowing decision will affect those firms not selected by eliminating or reducing the future funding from this program.

1.3 ALS ENVIRONMENTAL ISSUES ANALYSIS

In order to provide the Air Force and DOD decision makers with a broad understanding of the environmental issues associated with each candidate ALS concept, an environmental constraints survey was conducted. This analysis included an evaluation of the major components of each ALS concept and their potential effects on environmental resources and elements of public health and safety.

1.3.1 ALS Concepts

To meet the ALS requirements five ALS concepts have been submitted to Space Division for evaluation. Brief summaries of the five concepts are presented here. More detailed summaries are included in Section 2.2.2.

1.3.1.1 Boeing Company

The Boeing proposal consists of a liquid fueled (LO_2/LH_2) core vehicle and three strap-on booster options. The three basic booster options include liquid (LO_2/LH_2) boosters, liquid "flyback" boosters, and solid rocket booster options. Boeing also proposes to recover the core P/A module on land near the launch site and the booster P/A module from the ocean. The land recovery option will require a six square mile recovery area near the launch site.

For the normal mission model (20-30 launches) Boeing proposes all ALS missions to be processed at and launched from two existing, although modified, launch complexes (LC 34 and LC 37) at Cape Canaveral Air Force Station (CCAFS), Florida. For the expanded mission model (40-50 launches) Boeing proposes to modify existing launch complex SLC-6 and monitor proposed SLC-7 (for future use) at Vandenberg Air Force Base (VAFB).

1.3.1.2 General Dynamics Corporation

General Dynamics proposes a liquid fueled core vehicle with both a liquid (LO_2/LH_2) and a solid rocket strap-on booster options. The liquid booster P/A modules are water-recoverable while the core engines are expendable and burn up on re-entry. General Dynamics proposes to modify existing launch facilities at CCAFS (LC 34 and LC 37) and construct two launch complexes on Sudden Flats at VAFB.

1.3.1.3 Martin Marietta Corporation/McDonnell Douglas

Martin Marietta Corporation/McDonnell Douglas (MMC/MD) propose a liquid fueled core vehicle. Three booster options include expendable liquid (LO_2/LH_2) boosters, flyback liquid strap-on boosters, and expendable solid rocket boosters. The flyback booster is land recoverable near the launch site and may glide back or be under powered flight.

Proposed launch sites include Kennedy Space Center (KSC) near LC 39a, VAFB (Sudden Flats) and an optional launch location on the southeast coast of the island of Hawaii near South Point. The Hawaiian option could support both equatorial and near-polar orbits. If Hawaii is selected KSC and VAFB would not be needed. The optional near-shore and off-shore launches could be from KSC, and VAFB or Hawaii.

In addition to the land launch concepts, MMC/MD propose optional near-shore and off-shore launches. An additional optional west coast staging area for sea launches would be at Port Hueneme. The off-shore launch concepts include mobile jack-up platforms and semi-submersible platforms.

1.3.1.4 Rockwell International

Rockwell proposes a liquid fueled core vehicle with two basic strap-on booster options. The first option is a single liquid fueled (LO_2/LH_2, LO_2/RP-1 (kerosene), or LO_2/LCH_4 [methane]) booster. The second booster option consists of the use of solid rocket boosters. An additional alternative includes a flyback liquid fueled booster which will return to a landing strip near the launch site. The core payload P/A module is also recoverable.

Rockwell proposes a launch complex at KSC (north of LC 39) and use the existing SLC-6 complex at VAFB with an option for developing a land launch facility on the southeast coast of the island of Hawaii near South Point.

1.3.1.5 United Technologies Corporation

United Technologies Corporation (UTC) proposes a liquid-fueled core vehicle with three basic strap-on booster configurations. The first booster option incorporates completely expendable solid rocket boosters. The second is similar, but portions of the solid rocket booster systems are recoverable. The third booster option incorporates a liquid (LO_2/LH_2) flyback booster with fixed wings. Under the partially recoverable system, the P/A module is parachuted back to the vicinity of the launch site and requires a relatively level six square mile area. The proposed launch sites under the UTC concept include two new launch complexes near existing complexes LC 14 and LC 15 at CCAFS, and two complexes southeast of SLC-6 at VAFB, which will require modification.

1.3.2 Environmental Issues

The evaluation of potential environmental issues associated with the ALS is designed to assist the Air Force and DOD decision makers in the narrowing decision. The objective of the constraints survey is to identify the resource areas where significant issues may occur and to provide an indication of the potential magnitude of these issues as

constraints to the ALS program. The evaluation of the potential issues of concern and the potential constraints on the ALS system is intended to provide the Air Force and DOD decision maker with a broad understanding of the environmental issues associated with each ALS concept. Following a review of the five basic candidate ALS concepts, and the various options included within them, potential environmental issues were identified and categorized within several broad areas of environmental concerns, including: geology, air resources, water resources, biological resources, cultural resources, visual resources, land use, socioeconomics, health and safety, and hazardous waste (Section 3.0). Due to the broad and yet complex nature of the candidate concepts, the variable nature of the information on the launch sites, the resource areas evaluated include sub-units that will be addressed in detail in future NEPA compliance documents. However, a broad evaluation of the potential affects that construction and deployment of the ALS may have on the resources of concern is presented in Section 3.0 and provides the input for an environmental issues analysis and development of an environmental issues matrix (Figure 1.1a-1.1c). The matrix indicates the potential levels of constraint resulting from the environmental issues associated with each candidate ALS concept.

The evaluation of potential environmental issues and potential constraints on the development of the ALS indicates similarity in the potential constraints for all concepts (Figure 1.1a-1.1c). The largest differences occur among the three launch areas with the Eastern Test Range (CCAFS, KSC) having fewer areas of high constraints than the west coast (VAFB) (Figure 1.1a-1.1c). The Hawaii launch location has the largest number of resource areas with high constraints.

Although minor differences occur among the candidate ALS concepts (Figure 1.1a-1.1c), some of these differences could be modified to lower or higher constraint levels by emphasizing elements of one or more of the various combinations of system options put forward by the proponents. All candidate concepts have potentially significant environmental affects which will require environmental analysis under NEPA when more detailed design data is available. The evaluation of the environmental issues associated with the ALS concepts, based primarily on east and west coast constraints, indicates no distinct discriminators that would allow them to be ranked on an environmental basis.

West Coast		Geology	Air	Water	Biology	Noise	Land Use	Visual	Cultural	Socioeconomics	Safety *	Toxic Hazards *
BOEING	Land Launch	●	◍	●	●	◍**	◍	●	●	◍	◍/◍	◍/●
	Near-Shore Launch											
	Offshore Launch											
GENERAL DYNAMICS	Land Launch	●	◍	●	●	◍	◍	●	●	◍	○/◍	◍/●
	Near-Shore Launch											
	Offshore Launch											
MARTIN MARIETTA/ MCDONNELL DOUGLAS	Land Launch	◍	◍	●	●	◍**	◍	◍	●	◍	◍/◍	◍/●
	Near-Shore Launch	◍	◍	●	●	◍**	◍	◍	●	◍	◍/◍	◍/●
	Offshore Launch	◍	●	●	●	◍**	◍	◍	◍	◍	○/◍	○/●
ROCKWELL	Land Launch	◍	◍	●	●	◍**	◍	◍	●	◍	◍/◍	◍/●
	Near-Shore Launch											
	Offshore Launch											
UTC	Land Launch	◍	◍	●	●	◍**	◍	◍	●	◍	◍/◍	◍/●
	Near-Shore Launch											
	Offshore Launch											

Figure 1.1A

ENVIRONMENTAL ISSUES MATRIX

Key
- ○ Low constraint
- ◍ Moderate constraint
- ● High constraint

Note: * Liquid/solid.

** High for flyback booster.

East Coast		Geology	Air	Water	Biology	Noise	Land Use	Visual	Cultural	Socioeconomics	Safety*	Toxic Hazards*
BOEING	Land Launch	○	○	○	●	○**	●	●	▨	▨	●/▨	▨/●
	Near-Shore Launch											
	Offshore Launch											
GENERAL DYNAMICS	Land Launch	○	○	○	○	○	○	○	○	▨	○/▨	▨/●
	Near-Shore Launch											
	Offshore Launch											
MARTIN MARIETTA/ MCDONNELL DOUGLAS	Land Launch	○	○	○	●	○**	●	●	▨	▨	▨/▨	▨/●
	Near-Shore Launch	○	○	●	●	○**	●	●	○	▨	▨/▨	▨/●
	Offshore Launch	○	○	●	●	○**	●	▨	○	▨	○/▨	○/●
ROCKWELL	Land Launch	○	○	○	●	○**	●	●	○	▨	▨/▨	▨/●
	Near-Shore Launch											
	Offshore Launch											
UTC	Land Launch	○	○	○	●	○**	●	●	▨	▨	▨/▨	▨/●
	Near-Shore Launch											
	Offshore Launch											

Figure 1.1B

ENVIRONMENTAL ISSUES MATRIX

Key
- ○ Low constraint
- ▨ Moderate constraint
- ● High constraint

Note: * Liquid/solid.

** Moderate for flyback booster.

Hawaii		Geology	Air	Water	Biology	Noise	Land Use	Visual	Cultural	Socioeconomics	Safety *	Toxic Hazards *
BOEING	Land Launch											
	Near-Shore Launch											
	Offshore Launch											
GENERAL DYNAMICS	Land Launch											
	Near-Shore Launch											
	Offshore Launch											
MARTIN MARIETTA/ MCDONNELL DOUGLAS	Land Launch	●	●	◍	●	●	●	●	●	●	◍/◍	●/●
	Near-Shore Launch											
	Offshore Launch	●	●	◍	●	●	●	●	◍	●	○/◍	◍/●
ROCKWELL	Land Launch	●	●	◍	●	●	●	●	◍	●	◍/◍	●/●
	Near-Shore Launch											
	Offshore Launch											
UTC	Land Launch											
	Near-Shore Launch											
	Offshore Launch											

Figure 1.1C

ENVIRONMENTAL ISSUES MATRIX

Key
- ○ Low constraint
- ◍ Moderate constraint
- ● High constraint

Note: * Liquid/solid.

2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.0 DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.1 PURPOSE AND NEED FOR THE ACTION

2.1.1 Background

The United States' space program is currently dependent on launch vehicles developed in the 1950's, 60's, and 70's. These vehicles are used to insert payloads into a variety of orbits ranging from low earth orbit (LEO) to geosynchronous earth orbit (GEO). LEO is closer to the earth and therefore requires less energy per pound of payload to achieve. Higher orbits require additional energy. GEO, the point at which a satellite's revolution around the earth matches the earth's rate of rotation, is the most distant orbit to which standard payloads are sent. GEO is commonly used for communications and weather satellites since a satellite in GEO stays over the same point on the earth's surface. In order to achieve GEO, many payloads are first put into LEO and then boosted into GEO with an upper stage motor.

The current fleet of U.S. launch vehicles has the capacity to lift payloads ranging from 500 to 65,000 pounds to equatorial LEO and from 500 - 30,000 pounds to near-polar LEO (Table 2.1). These vehicles can also be used to place smaller payloads in higher orbits.

Table 2.1. Current Payload Lift Capacities

Launch Vehicle	Payload Lift Capacity to Easterly LEO	Payload Lift Capacity to Near-Polar LEO	GEO
Scout	N/A	500 lbs	NA
Titan II	N/A	5,000 lbs	NA
Delta II	8,000 lbs	7,000 lbs	4,000 lbs
Atlas Centaur	12,000 lbs	NA	5,000 lbs
Titan 34D	30,000 lbs	30,000 lbs	5,000 lbs
Titan IV Centaur	39,000 lbs	23,000 lbs	10,000 lbs
Titan IV IUS	39,000 lbs	23,000 lbs	5,300 lbs
Space Shuttle	65,000 lbs	30,000 lbs	5,500 lbs

The difference in the payload lift capacities to equatorial and near-polar orbits is due to the additional energy required to achieve near-polar orbit. When a vehicle is

launched in an easterly direction the earth's rotation helps to "throw" the payload into orbit (Figure 2.1). A launch to a near-polar orbit requires much more energy to lift the same payload because the earth's rotation does not contribute as much energy to the flight. The direction in which the launches must occur for the differing orbits are also important since there are overflight restrictions at most launch sites to prevent the launch vehicles from lifting off over populated areas. For this reason the ALS requirement for both equatorial and near-polar orbits has resulted in the identification of six alternative sites:

- Existing and/or new launch sites at the Eastern Test Range (ETR) on Cape Canaveral Air Force Station (CCAFS) and NASA's Kennedy Space Center (KSC) in Florida (Figure 2.2);

- Existing and/or new launch sites at the Western Test Range (WTR) on Vandenberg Air Force Base (VAFB) in California (Figure 2.3);

- New launch sites on the southeast coast of the island of Hawaii (Figure 2.4);

- Fixed or mobile off-shore platforms at each of the three locations listed above and off Port Hueneme Naval Station, California (Figure 2.5).

The WTR has overflight restrictions which limit launches primarily to more or less polar orbits while overflight restrictions at ETR primarily limit launches to equatorial orbits (Figure 2.6).

The Saturn V, used for the manned lunar missions of the 1960's and early 1970's, and capable of lifting 300,000 lb. to earth orbit, no longer exists. The United States' largest current payload delivery systems are the Space Shuttle and Titan IV Centaur. The launch schedule for the Shuttle has been set back several years by the 1986 Challenger accident and payloads scheduled for launch have been backed up for years. An alternative means of deploying these payloads is needed.

The Advanced Launch System has been proposed to fill this vacancy in the U.S. fleet of launch vehicles. It will provide a lift capability of 150,000 pounds to equatorial LEO and 65,000 pounds to near-polar LEO with the potential for future increases. Payloads which were scheduled to be

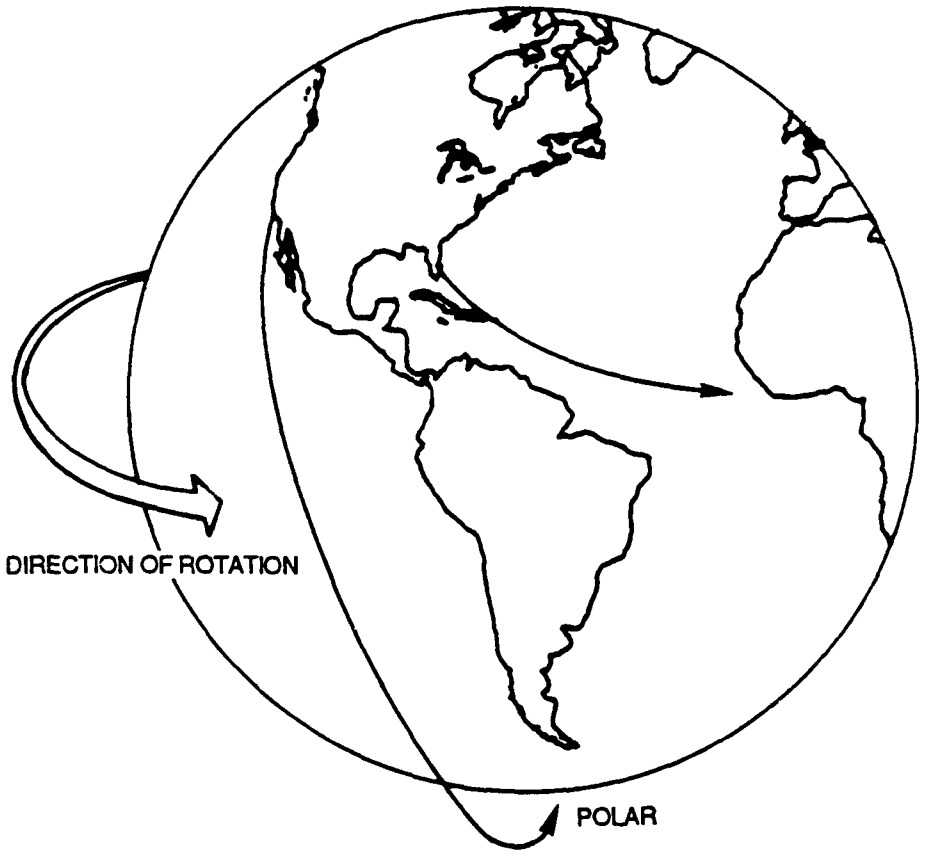


Figure 2.1

EQUATORIAL AND NEAR-POLAR ORBITS

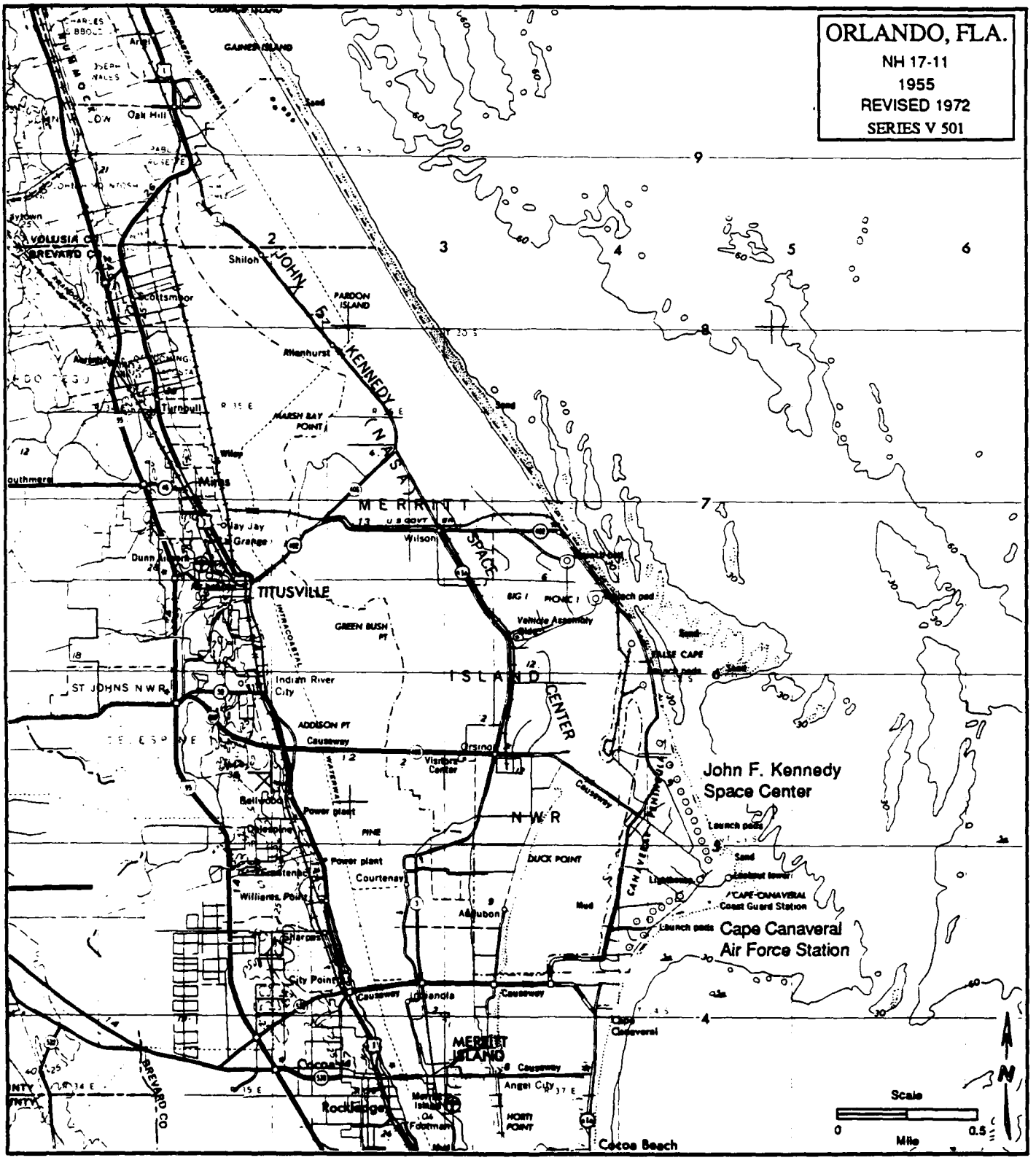


Figure 2.2

LOCATION OF ETR

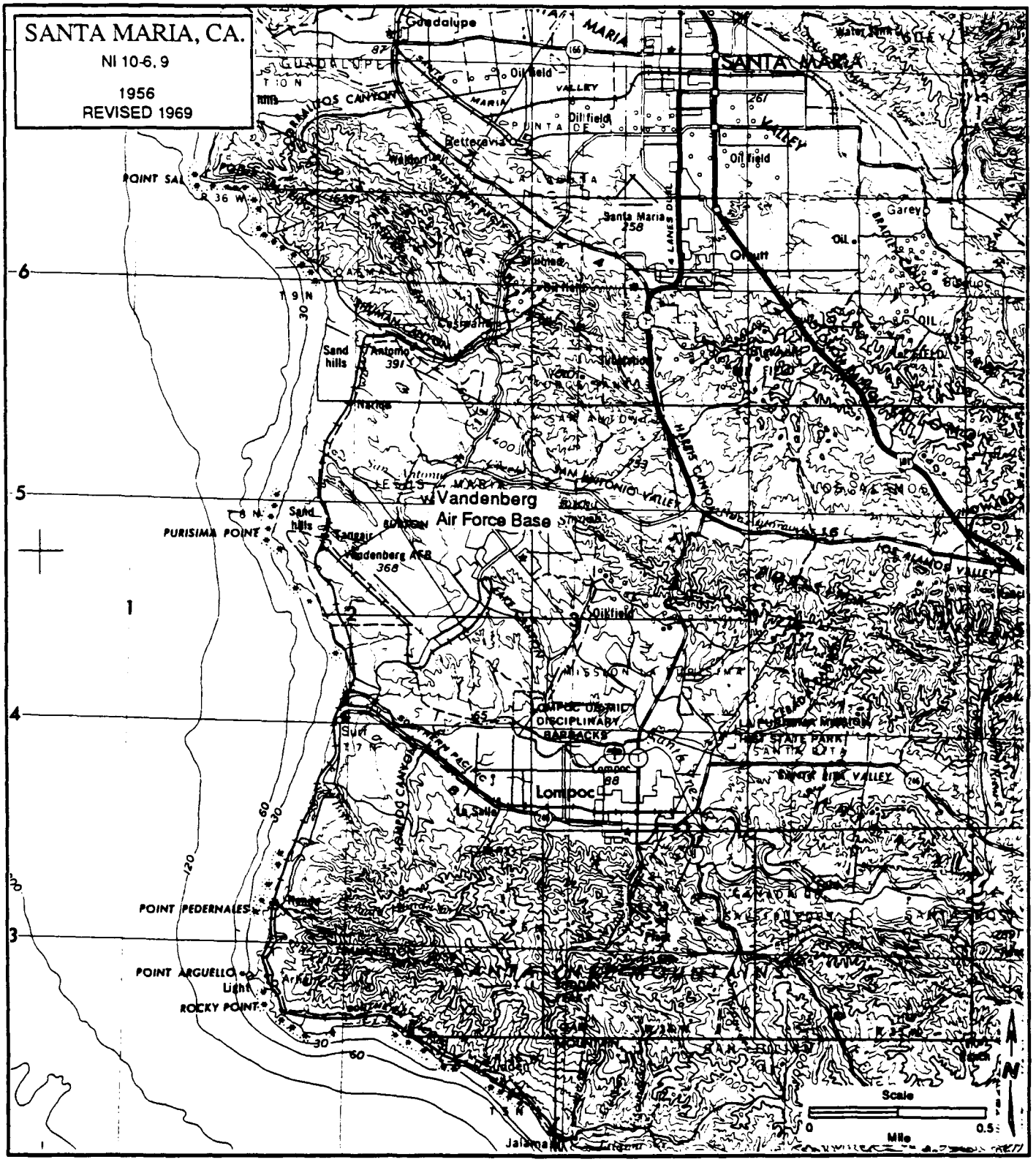


Figure 2.3

LOCATION OF WTR

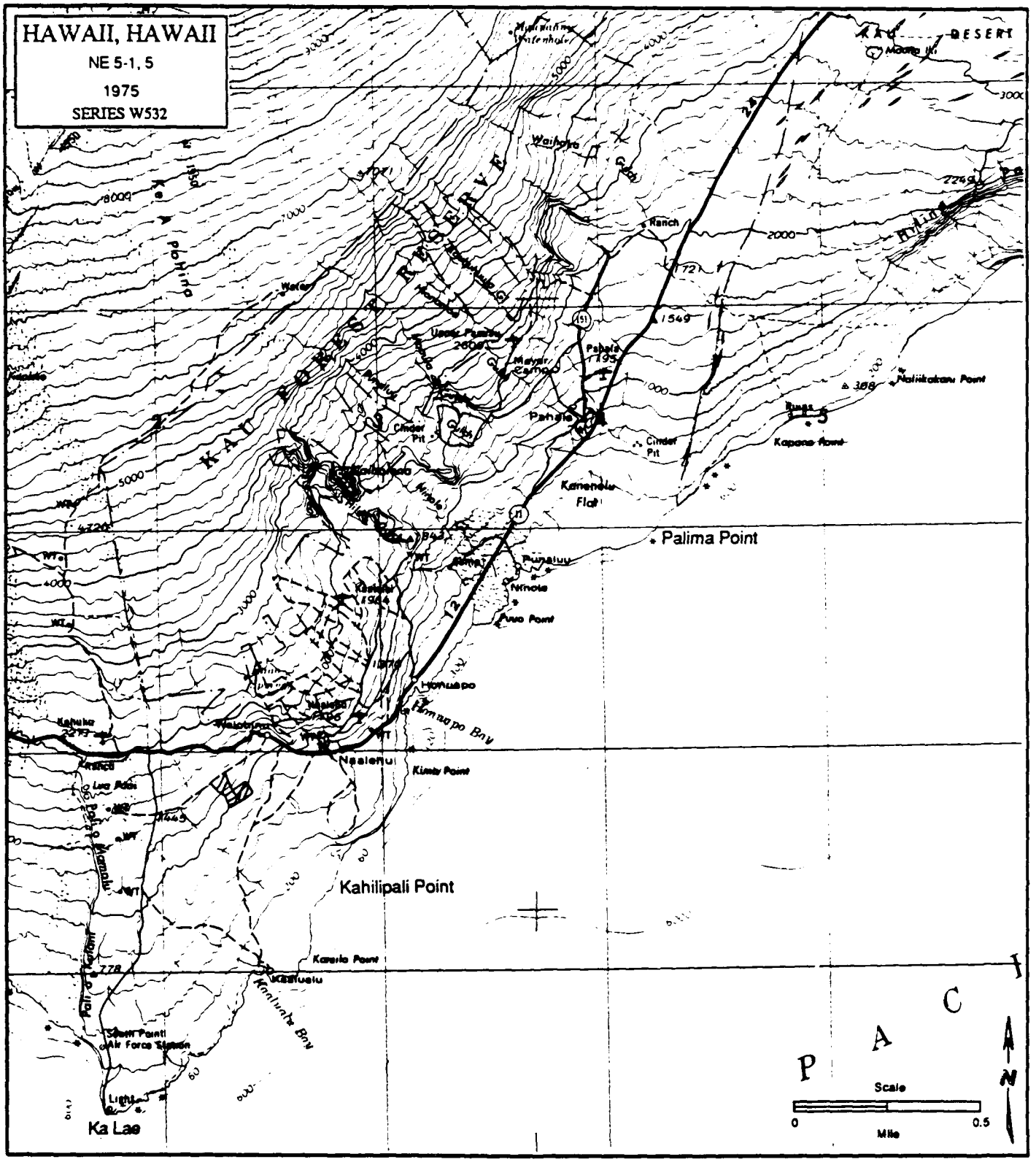


Figure 2.4

PROPOSED HAWAII LOCATION

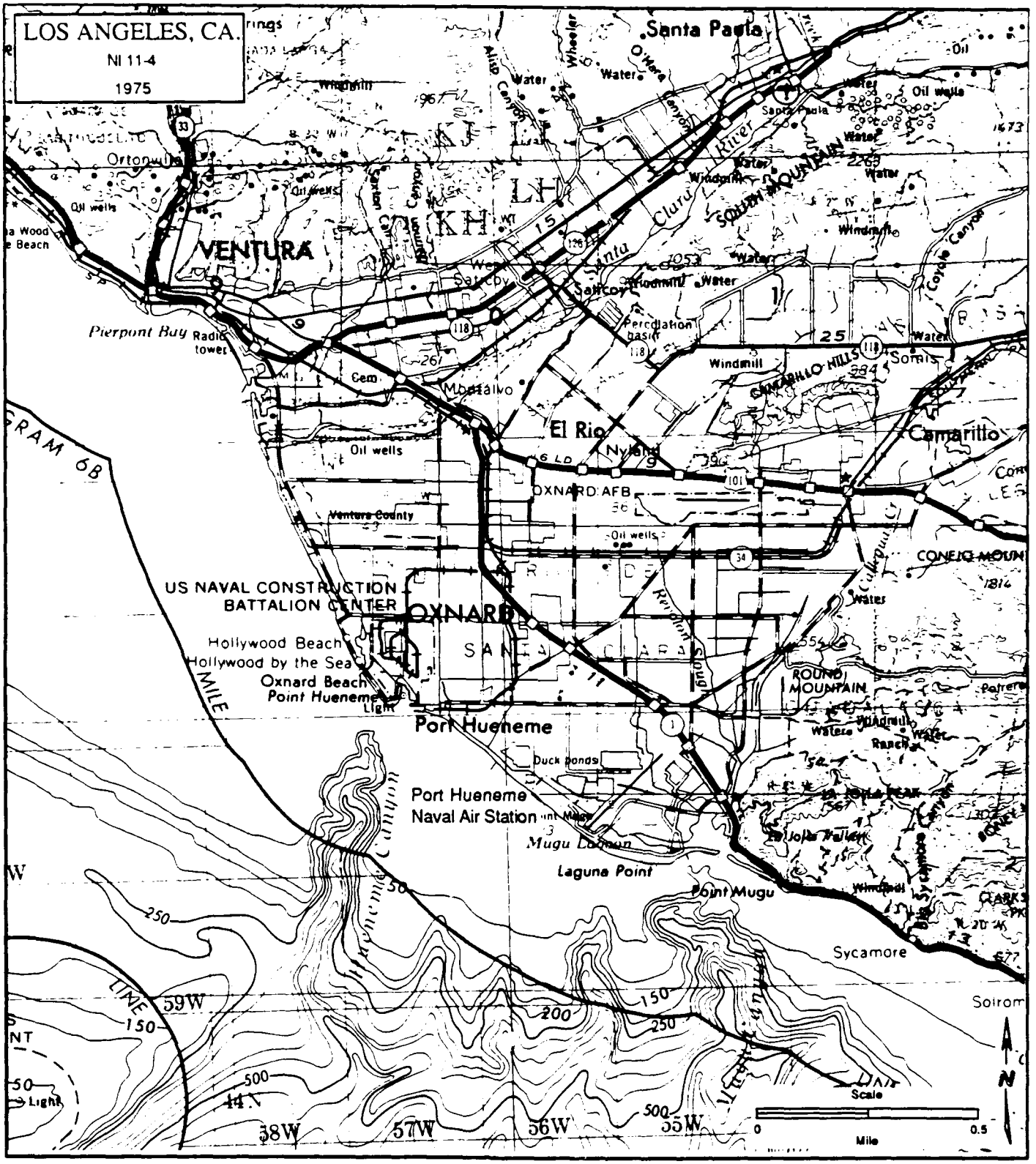


Figure 2.5

PROPOSED PORT HUENEME LOCATION

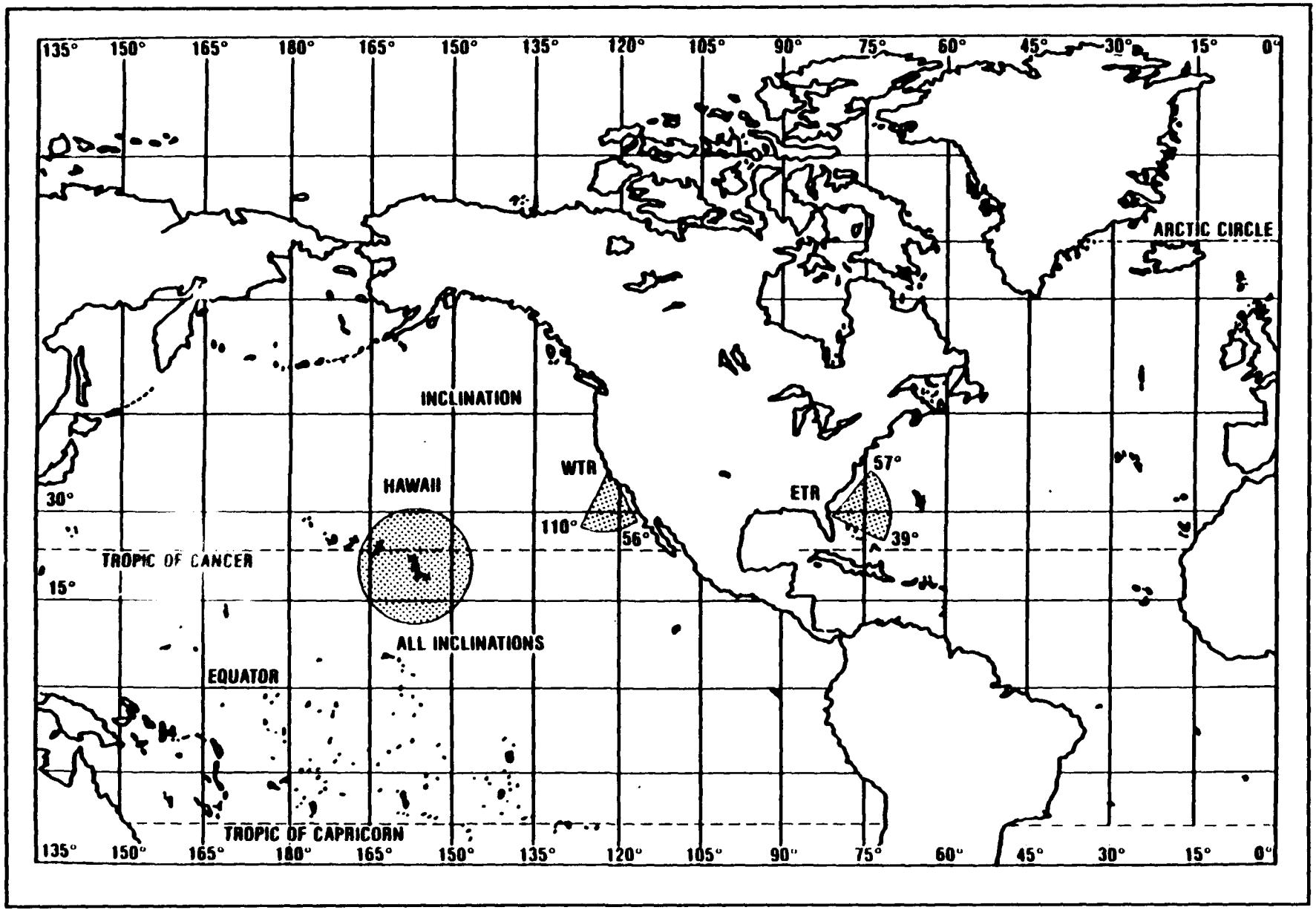


Figure 2.6

LAUNCH LIMITS

delivered on the shuttle may be accommodated on the ALS at a rate that would put programs which are seriously delayed back on schedule.

NASA will require many launches to lift all of the components of the space station into orbit. The ALS could lift much larger pieces at one time, allowing more assembly to be done on the ground, and the space station to become operational faster.

The Strategic Defense Initiative Organization (SDIO) is another potential user of the ALS. In order to deploy a space-based subsystem of the Strategic Defense System, a large number of payloads must be delivered to a variety of orbits.

2.1.2 General ALS Description

The ALS will be the U.S.'s primary means of inserting large payloads (65,000 to 190,000 pounds) into equatorial and near-polar LEO and GEO. Configurations are also being studied which would provide payload lift capability in excess of 300,000 pounds to near-polar orbit. The ALS is expected to have the capability of achieving 30 to 50 launches per year at a lower cost than current launch vehicles (Table 2.2).

Five contractors have currently developed concepts for ways to implement the ALS. These contractors started from a common baseline (Section 2.2.1) and produced operational concepts which, while quite similar, differ slightly in vehicle concept and in the facilities and equipment required to support the launches (operational concept) (Figure 2.7).

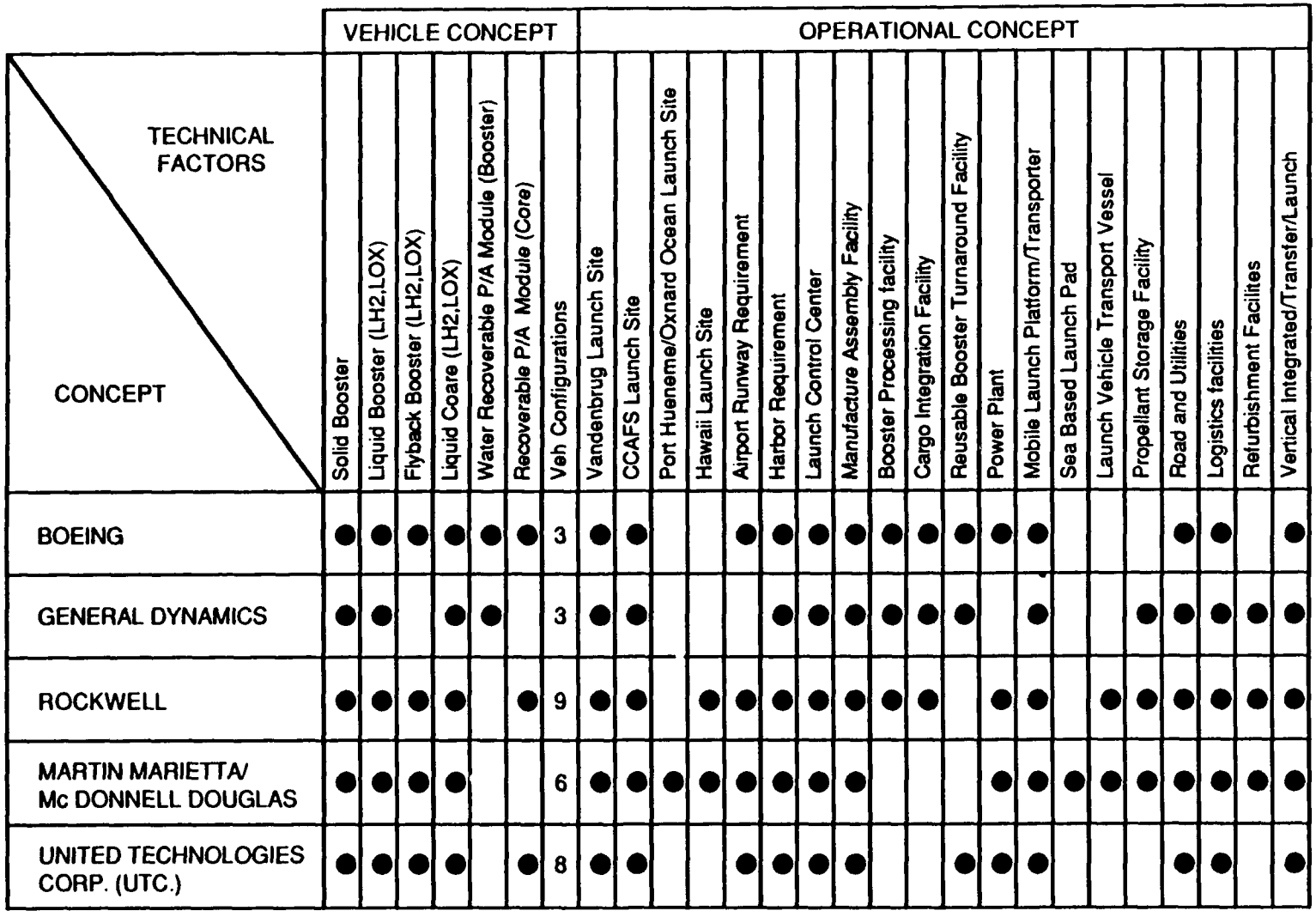
As currently envisioned, the ALS will consist of a liquid oxygen (LO_2), liquid hydrogen (LH_2) fueled core vehicle with strap-on boosters added to increase payload lift capability. Several types of boosters are being studied. These include expendable solid rocket boosters, a variety of expendable liquid-fueled boosters, and a recoverable winged liquid booster which will fly back to a landing strip near the launch site.

The currently proposed, liquid-fueled boosters, whether expendable or recoverable, will use the same fuels as the core vehicle. Optional liquid-fueled boosters include LO_2/RP-1 (kerosene) and LO_2/CH_4 (methane). The proposed solid boosters will use a solid fuel mixture which has less

Table 2.2

ALS Operational Requirments

	Payload Size	Payload Weight to Near-Equatorial Orbit	Payload Weight to Near-Polar Polar Orbit	Launch Rate Per Year		
				Equatorial	Polar	Total
Normal Mission Model	15 x 80 ft	100,000 to 150,000 lbs	65,000 lbs	18	12	30
Expanded Mission Model	43 x 125 ft	100,000 to 150,000 lbs	65,000 lbs	38	12	50
Standard Launch Vehicles - Maximum Launch Vehicles	43 x 125 ft	Not given	160,000 lbs	38	12	60
Surge Capability	43 x 125 ft	Not given	160,000 lbs	48	12	60
Growth Payload Vehicle	54 x 158	Not given	320,000 lbs	Not given	Not given	Not given



TECHNICAL FACTORS / CONCEPT	VEHICLE CONCEPT							OPERATIONAL CONCEPT																		
	Solid Booster	Liquid Booster (LH2,LOX)	Flyback Booster (LH2,LOX)	Liquid Coare (LH2,LOX)	Water Recoverable P/A Module (Booster)	Recoverable P/A Module (Core)	Veh Configurations	Vandenbrug Launch Site	CCAFS Launch Site	Port Huenemo/Oxnard Ocean Launch Site	Hawaii Launch Site	Airport Runway Requirement	Harbor Requirement	Launch Control Center	Manufacture Assembly Facility	Booster Processing facility	Cargo Integration Facility	Reusable Booster Turnaround Facility	Power Plant	Mobile Launch Platform/Transporter	Sea Based Launch Pad	Launch Vehicle Transport Vessel	Propellant Storage Facility	Road and Utilities	Logistics facilities	Refurbishment Facilites	Vertical Integrated/Transfer/Launch
BOEING	●	●	●	●	●	●	3	●	●			●	●	●	●	●	●	●	●	●				●	●		●
GENERAL DYNAMICS	●	●		●	●		3	●	●				●	●	●	●	●	●		●			●	●	●	●	●
ROCKWELL	●	●	●	●		●	9	●	●		●	●	●	●	●	●	●		●	●		●	●	●	●	●	●
MARTIN MARIETTA/ Mc DONNELL DOUGLAS	●	●	●	●			6	●	●	●	●	●	●	●	●				●	●	●	●	●	●	●	●	●
UNITED TECHNOLOGIES CORP. (UTC.)	●	●	●	●		●	8	●	●			●	●	●	●			●	●	●				●	●		●

Figure 2.7

ALS VEHICLE/OPERATIONAL CONCEPTS MATRIX

than three percent hydrogen chloride (HCl) in the exhaust products. This is expected to reduce the potential for launch impacts on air quality and biota near the launch.

Other portions of the ALS launch vehicle may also be reusable. Several concepts call for recovery and refurbishment of a module (P/A module) which contains the guidance and control equipment, and liquid-fueled engines and nozzles from the liquid-fueled boosters. The modules will be parachuted to recovery points on either land or water.

2.1.3 ALS Program Description

The Department of Defense's (DOD) Major Systems Acquisition Process (MSAP) is structured to allow the consideration of many potential means of achieving program goals in the early phases of the process. As the process continues and the concepts become better defined, the number of alternatives is reduced (Figure 2.8).

As a program proceeds through the MSAP, it progresses through four major phases. In the first phase, concept definition, the concepts are researched and emerging technologies are evaluated for their ability to meet mission needs. In the second phase, demonstration and validation, the results of research and technology development are demonstrated and validated in a systematic manner. The third phase is full-scale development. In this phase, engineering drawings, production planning, and fabrication of test articles are undertaken. Testing of full-scale prototypes also occur. The fourth phase is production and deployment of the system.

The MSAP is designed to ensure that succeeding phases are not undertaken until there is a high probability of their success. Each phase involves a greater commitment of resources than the prior one, and must be preceded by a formal decision to proceed. These "proceed" decisions are called "milestones" and are made by the Defense Acquisition Board (DAB). Milestone I is the transition from concept definition to demonstration and validation; Milestone II is the decision to proceed from demonstration and validation into full-scale development; and Milestone III is the decision to produce and deploy the system.

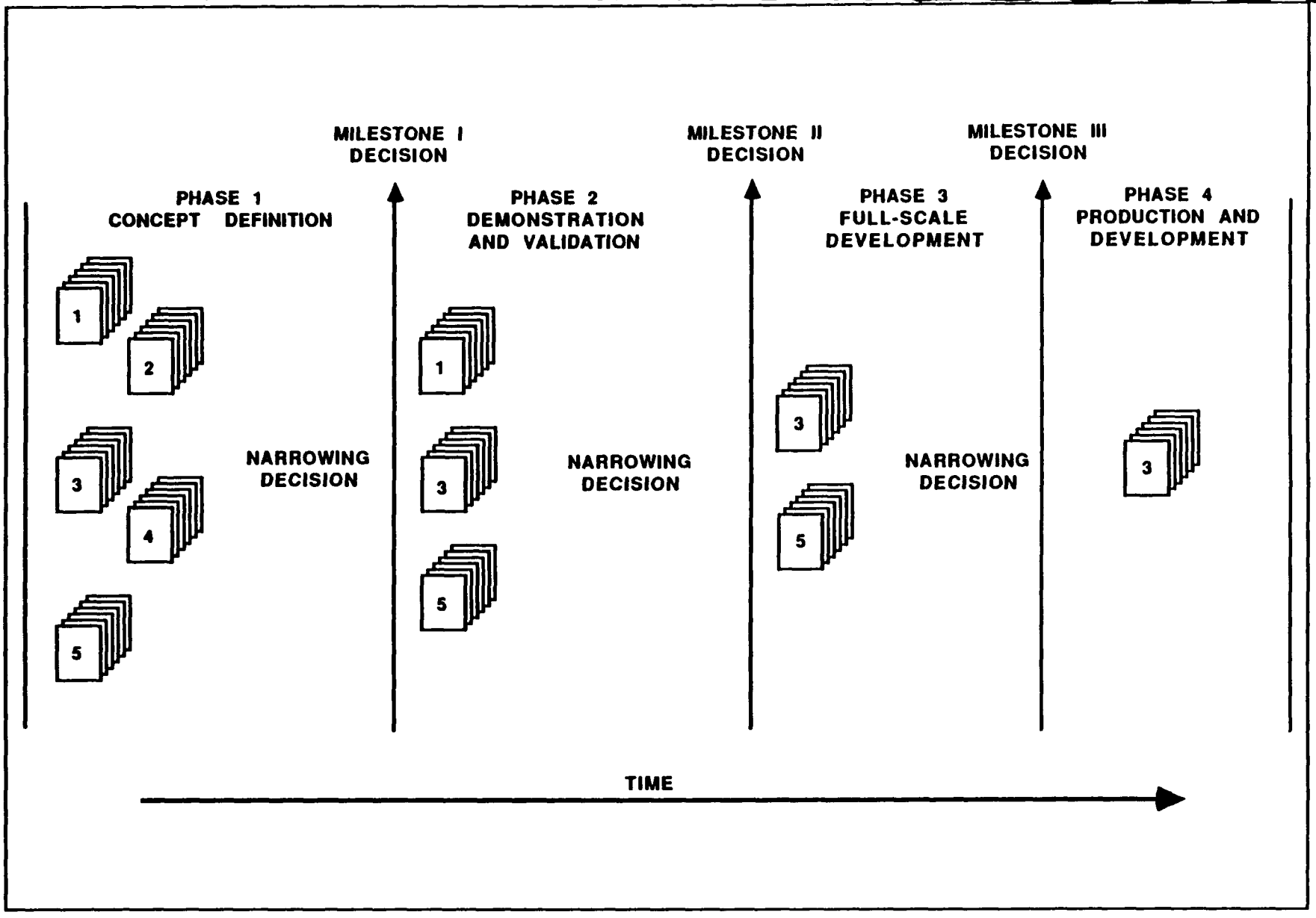


Figure 2.8

THE MAJOR SYSTEMS ACQUISITION PROCESS (MSAP)

Prior to Milestone I, and sometimes Milestone II, the candidate concepts are reviewed and a "narrowing" decision is made to reduce the number of proposals or concepts that are being funded. The milestone decision is made to begin the next phase with the most viable concepts. This progressive reduction in the number of concepts focuses effort and money on the concepts most likely to achieve the goals of the program.

2.1.3.1 ALS Environmental Issues Analysis

This preliminary environmental constraints survey provides the Air Force and the DOD with a broad understanding of the environmental issues associated with each candidate ALS concept. The environmental issues analysis includes an evaluation of the major components of each concept and their potential effects on environmental resources and elements of public health and safety. This will allow the decision maker to consider these issues during the decision process. Detailed analysis of the environmental impacts of candidate concepts selected to proceed will be addressed in future environmental documentation when more design data are available.

2.2 SYSTEM DESCRIPTION

The five proposals discussed below have many similarities since all five contractors started with the same ALS requirements. Rather than listing all the components of the system each time, Section 2.2.1 will highlight the similarities among the five proposals and Section 2.2.2 will focus mainly on those factors which make each proposal different from the others.

2.2.1 General Description of the Five Concepts

Five contractors, Boeing Company, General Dynamics Corporation, Martin Marietta Corporation/McDonnell Douglas, Rockwell International, and United Technologies Corporation, have developed proposals for meeting the baseline criteria in order to achieve ALS mission requirements.

Each of the five proposals either meet or exceed all of the ALS criteria. The five contractors developed similar approaches to meeting the criteria, and as a result, all five are similar in many respects, including vehicle design, facilities required, and the location of launch sites.

2.2.1.1 Vehicle Concepts

The three main vehicle concepts being proposed all consist of an expendable core vehicle that uses a liquid oxygen/liquid hydrogen (LO_2/LH_2) propellant, an expendable payload shroud (which covers and protects the payload), and a variety of "strap-on" boosters to increase the payload lift capacity of the vehicle. The types of strap-on boosters being studied include: expendable solid rocket boosters; expendable liquid-fueled boosters (with engines similar to those used for the core), and recoverable liquid-fueled boosters (also similar to the core engines). One of the recoverable boosters is a liquid-fueled "flyback" booster, which is capable of flying or gliding back to a landing strip near the launch site, where it will be refurbished and reused. The other proposal is a liquid-fueled booster which is parachuted to a downrange ocean recovery site and returned to the ALS complex by boat. As a cost-saving measure, some of the contractors envision a recoverable propulsion/avionics (P/A) module from the liquid boosters or the core vehicle (Section 2.1.2). The P/A module contains guidance and control equipment, engines, and nozzles, and would be recoverable by parachute, either on land or at sea, and then be refurbished for use in later missions. The remainder of the vehicle would deorbit after use, and burn up upon re-entry into the earth's atmosphere.

2.2.1.2 Launch Site Locations

To satisfy the requirement for both equatorial and near-polar launches, VAFB and KSC are proposed as co-launch locations. A launch site in Hawaii would satisfy the launch requirements without an additional facility elsewhere.

All of the concepts involve using new and/or existing launch facilities at CCAFS or KSC in Florida. Facilities are proposed near existing launch complexes 39 A/B (the Space Shuttle launch complexes), 14, 15, 34, and 37.

All of the concepts also propose launch facilities at VAFB in California. The contractors plan to either utilize the existing Shuttle Launch Complex (SLC)-6 facilities at VAFB, or construct new facilities in the Sudden Flats area in the southern part of the base. Some assembly facilities related to the ALS program are also planned for the industrial area in north VAFB. All ALS concepts appear to require some realignment of the existing Southern Pacific Railroad track within VAFB or a major shift to the east. Based on the available information, all ALS concepts are assumed to

require modification of the Point Arguello Harbor through expansion of the harbor and its associated facilities or through an increase in frequency of the maintenance dredgings.

Proposed alternatives for these sites include new assembly and launch facilities on the southeast coast of the Island of Hawaii, and an offshore launch complex which uses Port Hueneme Naval Station, California for its port facility.

2.2.1.3 Facilities Required for ALS

All five contractors propose the operational concept of integrate, transfer and launch (ITL) for the ALS program. ITL involves the assembly of the launch vehicle on a mobile launch platform away from the launch complex. After the vehicle is fully assembled on the mobile launch platforms, it is transported to the launch complex, fueled, and launched. The advantage of ITL is that the launch complex is not tied up while a vehicle is being assembled, allowing an increased number of launches from that pad.

Since all of the concepts involve ITL, the types of facilities required for each concept are somewhat similar. All of the concepts require a large vehicle integration facility (VIF) where the components of the vehicle are assembled and prepared for launch, new or modifications of existing launch complexes, a launch control center, fuel storage facilities, and new roads and utilities. Some of the concepts call for the payload to arrive fully encapsulated, and ready to mount on the vehicle, while others propose a cargo integration facility for preparation of the payload. Some of the contractors proposed separate facilities for the processing of the booster components, particularly the solid rocket boosters, which involve the handling of hazardous materials.

Table 2.3 lists the common facilities required for the expendable solid booster, expendable liquid booster, and recoverable liquid booster options. Table 2.4 lists facilities common to SRB options. Each contractor has proposed slightly different facilities than those listed in Tables 2.3 and 2.4. Those given in the tables are intended as generic lists.

Table 2.3 Common Facilities Required for All Booster Options

Operations Control Center
Administrative Offices
Manufacturing Facility
Booster Processing Facility
Vehicle Integration Facility
Cargo Integration Facility
Storage Tanks for Liquid Propellants
Storage Tanks for Purge Gases (Helium, Nitrogen)
Water Tanks for Deluge System
Retention Pond for Deluge System
Launch Pad
Roads
Railroads
Crawlerways

Table 2.4 Additional Facilities for Solid Propellant Booster Options

Solid Booster Storage Facility
Booster Refurbishment Facility (Recoverable SRB)

Those concepts which involve recoverable components (P/A modules, liquid boosters, or flyback boosters) will require refurbishment facilities. Runways are required for the recovery of flyback boosters, and clear landing areas are needed for the land recovery of P/A modules.

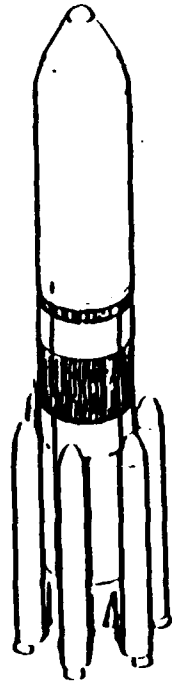
Some of the concepts involve optional capabilities for near-shore or sea-based launch operations. For both the near-shore and sea-based operations, vehicle processing would take place at land-based facilities. Near-shore launch would involve the construction of a stationary launch facility(s) less than one mile from shore and connected to land by a causeway for transportation of the launch vehicle. Sea-based launch would be carried out in deep water three to five miles from shore, but could be further from shore depending on water depth and line of site requirements to the launch control center. The sea launch options would use either a stationary platform similar to an oil platform, or a mobile launch pad. For a stationary launch platform, the vehicle would be placed on a transport vessel and delivered to the launch site. For a mobile system, the vehicle would be placed directly on the mobile launch pad and towed out to sea. In all cases, the vehicle would be fueled at sea from a propellant transport vessel just prior to launch. Mobile launch pads under consideration include a jack-up platform, similar to those used for oil exploration, which is moved by sea-going tugs and utilizes legs that can be lowered and anchored to the ocean floor; or a semi-submersible platform which is basically a free-floating unit moved by sea-going tugs or its own propulsion system, that can be anchored in place for launch.

2.2.2 Candidate Concept Proposals

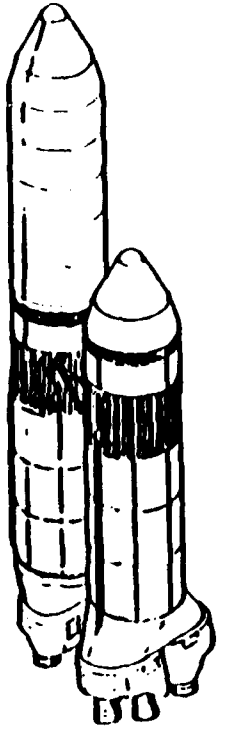
2.2.2.1 Boeing

Vehicle Concept

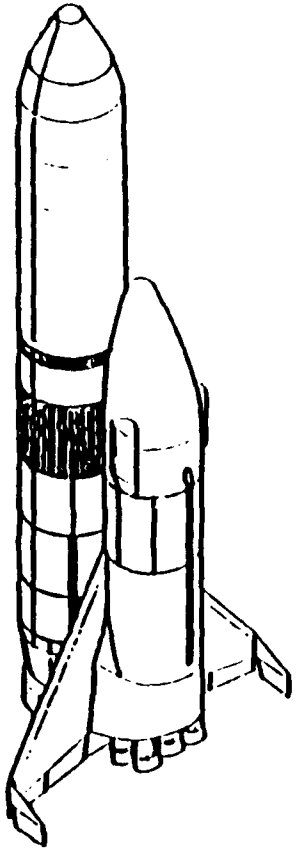
The Boeing proposal consists of three strap-on booster options, liquid, solid and flyback liquid, all attached to a liquid-fueled core vehicle (Figure 2.9). The liquid booster option has a water-recoverable booster P/A module, while the core P/A module orbits the earth once, deorbits, and is recoverable on land via parachute landing near the launch site. The solid booster option could use as many as six monolithic solid boosters to launch payloads from 76,000 to 160,000 pounds. There is also a two-stage expendable solid booster option. The core vehicle P/A module is recoverable on land near the launch site via parachute while the liquid



Solid Rocket
Booster Baseline



Liquid Rocket
Booster Baseline



Flyback Booster
Vehicle Baseline

Figure 2.9

BOEING VEHICLE CONCEPT

booster P/A module is water-recoverable, also via parachute. For recovery near the launch site the core vehicle must circle once around the earth. Payloads from 76,000 pounds to 160,000 pounds can be launched with the solid booster option depending on the payload orbit. The liquid flyback booster vehicle can launch payloads up to 110,000 pounds. The vehicle life is estimated at 50 missions for the P/A module and 200 missions for the flyback booster which lands near the launch site using air breathing engines.

Operational Concept

Boeing's proposal includes a family of both liquid and solid rocket boosters, with each option imposing different facility requirements. Boeing's consolidated operations concept includes all three configurations, discussed in 2.2.1.1. Several operations are common to all vehicle configurations. WTR operations will be identical to those at ETR, except that WTR will have no major manufacturing facilities. All large tank modules, etc. for WTR will be manufactured/fabricated at CCAFS and shipped to VAFB via barges through the Panama Canal. The components will be integrated into a completed vehicle at VAFB.

Launch Sites

Florida

For the normal mission model (20-30 launches per year), all ALS missions are proposed to be processed and launched at CCAFS. The ALS launch facilities at CCAFS include two launch pads, one at LC 34 and another near the west pad of LC 37. Depending on future design, these pads may be new or involve modifications to existing facilities.

California

For the expanded mission model (40-50 launches per year), launches from VAFB are required. ALS launch facilities at VAFB will consist of modifications to SLC-6 and the assembly, integration, and check-out facilities. Boeing has assumed that SLC-6 will be available for modification for ALS use. The facilities required at VAFB for this proposal would be similar to those listed in Tables 2.3 and 2.4. New facilities, roads, railroads, and propellant storage sites would be required. The major vehicle and logistics elements and possibly propellants would require water transportation via barge.

2.2.2.2 General Dynamics (GD)

Vehicle Concept

The GD vehicle concept uses liquid-fueled core vehicle with either liquid or solid strap-on boosters (Figure 2.10). Both core and liquid boosters (LB) are 30 feet in diameter, approximately 165 feet high and use similar engines. The liquid booster engines are water-recoverable via parachutes. The core vehicle contains a solid rocket motor to deorbit the core after payload deployment in order to safely destroy the core. The core engines are expendable and burn up during reentry. The solid booster option uses a variety of monolithic boosters to meet the various payload lift requirements.

Operational Concept

The GD operations concept consists of core/booster assembly, final assembly on the launch site, and a consolidated assembly-integrate-transfer facility which includes pre-launch processing and mission operations. GD would co-locate the pre-assembly and final assembly facility with the ground processing facilities so that the core vehicle and boosters can be completely assembled and checked out prior to integration activities. When fully integrated and checked out, the vehicle is moved via a mobile launch platform to a launch complex where it is fueled and launched.

The core is delivered horizontally from the assembly facility to the vehicle integration facility (VIF) where it is erected onto the mobile launch platform (MLP). The VIF is used to integrate the solid booster option in order to isolate the hazardous operations associated with solid rocket motor handling. The vehicle is then moved to the cargo integration facility for cargo integration. The VIF can be used to process the liquid versions if it is not used for solid boosters. Normally, the cargo integration facility is where the liquid booster and core are integrated and also used by the payload integration to assemble the cargo. Cargo elements are delivered to a build-up cell where they will be integrated with other elements. The fairing is also delivered and assembled in the cargo integration facility where it is moved into an encapsulation room to enclose the cargo. The encapsulated cargo is then transferred to a high-bay area and mated to the vehicle.

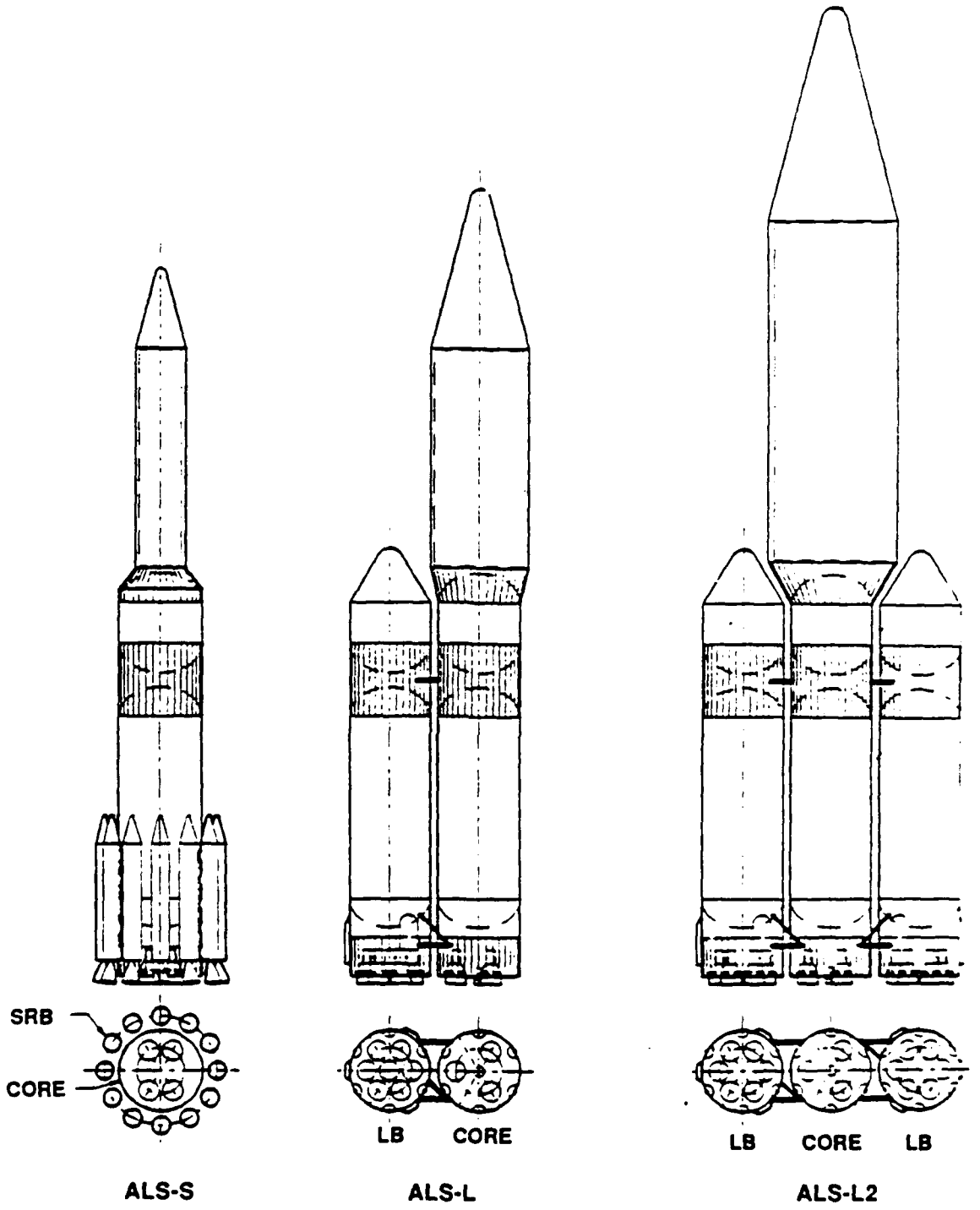


Figure 2.10

GENERAL DYNAMICS VEHICLE CONCEPT

Launch Sites

Florida

The east coast launch locations are proposed at CCAFS at LC 37 and LC 34 (Saturn 1B) pad sites with ground processing facilities located in the CCAFS industrial base area. Depending on future design, these pads may be new or involve modifications to existing facilities.

California

The west coast sites are at VAFB with two launch complexes in the Sudden Flats area. The complexes would be two miles due east of the Point Arguello harbor with consolidated assembly/integrate/transfer facilities another four miles southeast between Point Arguello and Jalama Beach. The remaining facilities not directly associated with vehicle processing would be located in or near the industrial area of north VAFB. New facilities, roads, railroads, and propellant storage sites will be required. The major vehicle and logistics elements and possibly propellants will require water transportation via barge.

2.2.2.3 Martin Marietta Corporation/McDonnell Douglas (MMC/MD)

Vehicle Concept

The MMC/MD proposal consists of a liquid-fueled core vehicle with either liquid or solid strap-on boosters (Figure 2.11). The core vehicle contains a deorbit engine which causes the core to tumble and burn up during reentry after cargo deployment. The launch vehicle dimensions vary with the different options and configurations. The launch vehicle can carry from four to eight expendable solid or liquid-fueled boosters or one or two liquid flyback boosters depending on the size of the payload to be lifted.

The solids are monolithic (rather than segmented like the solid boosters used on the Shuttle). The liquid flyback booster is land recoverable near the launch site and may glide back or be under powered flight.

Operational Concept

The MMC/MD ALS operations of ITL has payloads (cargo), propulsion modules, avionics modules, core vehicle and boosters assembled and integrated at the launch site.

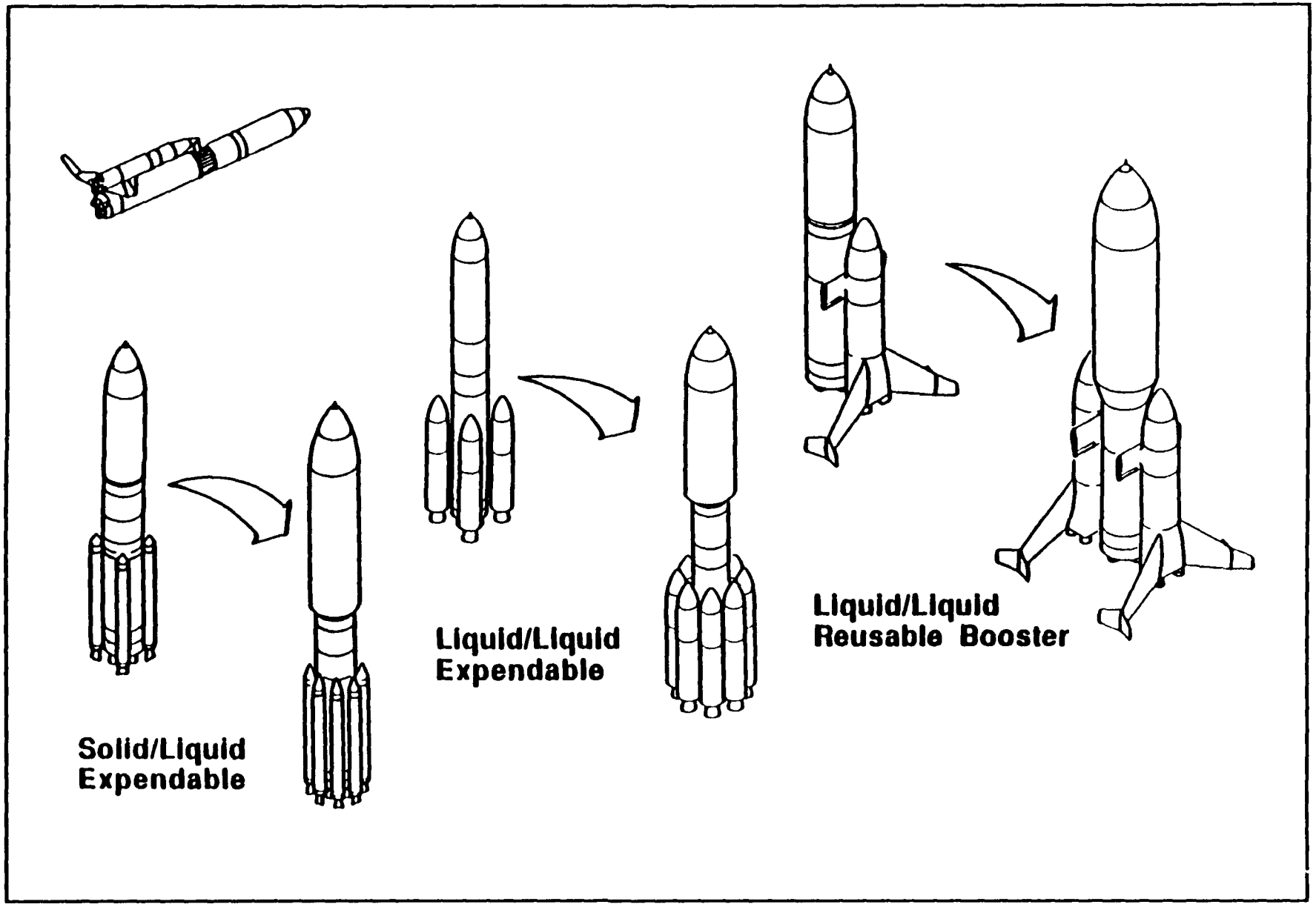


Figure 2.11

MARTIN MARIETTA/Mc DONNELL DOUGLASS VEHICLE CONCEPTS

Payloads arrive at the cargo integration facility where they are encapsulated and transported to the vehicle integration facility. The core vehicle is assembled at the core assembly building and similarly transported to the VIF. The boosters are assembled at the booster processing facility. The solid rockets would be manufactured off-site and transported to the launch site via barge. The boosters would be moved from a storage facility to the VIF where the core, booster, and cargo would be integrated prior to transport to a launch complex via a mobile transporter.

The facilities required for ALS operations under this concept would be similar to those listed in Tables 2.3 and 2.4.

Launch Sites

The MMC/MD proposal includes two new launch pads located on Sudden Flats in south Vandenberg, three new launch complex options located at CCAFS, three new sites on the southeastern coast of Hawaii (optional), and Port Hueneme/Oxnard off-shore area (optional). This is the only proposal to include an option which uses Port Hueneme Naval Station and one of only two to have a fully developed sea-based launch capability. This proposal includes three possible options: near-shore fixed platforms; off-shore mobile jack-up platforms; and off-shore mobile semi-submersible platforms.

Florida

Three launch complex options are proposed for KSC near LC 39A. New facilities include the VIF, launch pad, booster processing and storage, cargo integration facility (CIF), and launch control complex. Modifications of existing available facilities will be maximized.

California

Maximum use of existing industrial facilities at north and south VAFB is planned. New facilities include the VIF, two launch pads, booster processing and storage facilities, the cargo integration facility, and the launch control complex. The existing power facility near SLC-6 may not be adequate. Barge transportation to Point Arguello harbor will be required for the sea-based option.

The Port Hueneme/Oxnard location supports sea-based launch sites. No existing facilities exist; new facilities include VIF, booster processing and storage, cargo integration facility, launch control center, launch vehicle transport vessel, and propellant transfer vessel. The launch pad can be jack-up platform, fixed platform, or semi-submersible. The Oxnard Harbor District will require harbor expansion for the jack-up and semi-submersible access options.

Hawaii

For the Hawaii option MMC/MD recommends two on-land launch pads. No existing facilities exist; new facilities include VIF, launch pad, booster, processing and storage, payload processing facilities, cargo integration facility, and launch control complex.

2.2.2.4 Rockwell

Vehicle Concept

The Rockwell proposal contains two major options, each of which incorporates parallel stacking of a booster against a core vehicle (Figure 2.12). In every case the core vehicle utilizes LO_2 and LH_2 as the propellants. There are two basic configurations among the booster proposals. The most common is the use of a single liquid-fueled booster. The second version consists of use of solid boosters. Rockwell proposes using a liquid flyback booster which will separate on staging and return to a landing strip near the launch site for recovery and reuse. The core payload avionics module (PAM) is planned to be recoverable.

Operational Concept

The concept of operations for all three of the Rockwell proposed sites have similar facility requirements. Each proposes the use of ITL, cargo integration at a central point, horizontal stacking (of the payload/cargo), vertical stacking of the core, shroud and booster/solid rocket motors, crawler transportation to the launch pad, loading and fueling on the mobile launch pad, and launch. Rockwell proposes local on-site assembly capability to support launches.

Rockwell proposes using all three of the prospective operating sites: VAFB, KSC, and Hawaii. VAFB and KSC are offered as prospective co-locations to satisfy the requirement for both equatorial and near-polar launches.

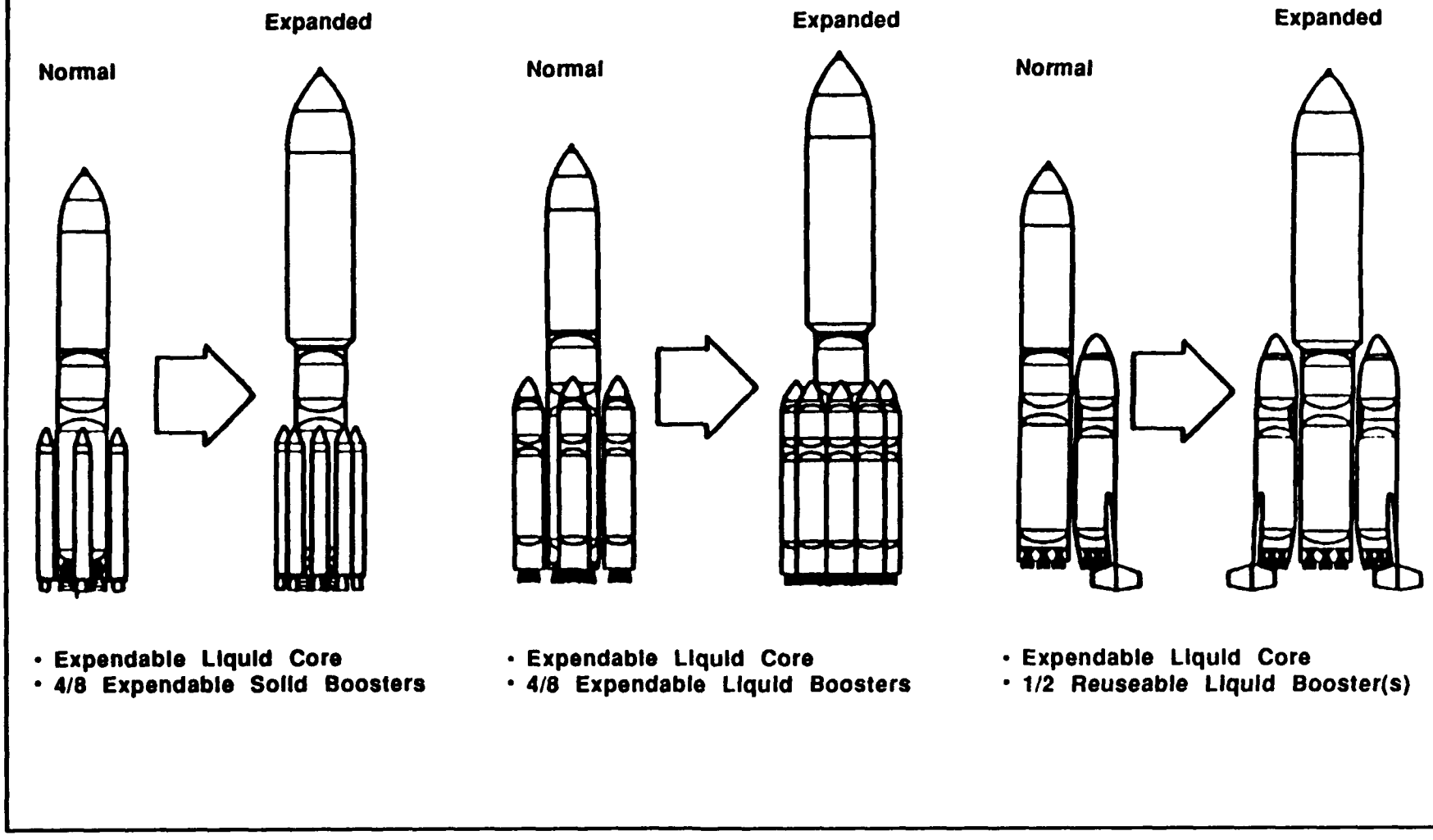


Figure 2.12

ROCKWELL VEHICLE CONCEPT

While the VAFB option will only satisfy the near-polar requirement and would have to be in combination with KSC, the Hawaii option serves the requirements for both equatorial and polar launches. The facilities required for ALS operations under this concept would be similar to those listed in Tables 2.3 and 2.4.

Launch Sites

Florida

Rockwell proposes essentially the same launch facilities as for the Western Test Range and VAFB. On-site propellant manufacturing, repair and modification of components, propellant and inert gases storage, purging, leak detection, blanket applications, water storage (domestic and deluge/acoustic dampening) and power requirements are similar.

California

The Rockwell proposal assumes that SLC-6 at VAFB will be available for use by ALS. Proposed facility construction at VAFB will consist of modifying SLC-6 and construction of:

- a launch control center
- the cargo integration facility
- the primary/launch power generation building/substation
- road (widening and upgrade) which will be required between the cargo integration facility/power generation facility/launch control and SLC-6
- project facility relocation requirements includes specification for relocation of existing coastal railroad tracks (several hundred yards).

At VAFB, provisions are made for storage and distribution of water, propellants, inert gases used to purge systems, and propellant manufacture. Road and crawlway development will be extensive.

Hawaii

The Rockwell Hawaii proposal uses Palima Point on the island of Hawaii. Initial construction will provide one each of the launch pad and support facilities requirements. Later phases of construction will add an additional mobile launch pad, and vertical integration building.

A launch site located on the southern tip of the island of Hawaii at Palima Point has the advantage of launch capability to both equatorial and near-polar orbits. Although not expressed, it is implied that the selection of this option would obviate the need for VAFB and KSC operations. A dock for unloading of vehicle components will be required. A complete infrastructure of warehouses, shops, landing strips, etc., will have to be constructed or existing facilities upgraded in order to provide the industrial base to support the proposed launch site.

2.2.2.5 United Technologies Corporation

Vehicle Concept

The UTC vehicle concept uses a liquid-fueled core vehicle featuring expendable, recoverable, and flyback booster options. There are three basic configurations among the booster proposals (*Figure* 2.13). The first is the complete expendable with either four, six, or eight solid boosters added depending on payload size. The total structure is 249 feet long and 35 feet in diameter and can orbit a payload size from 78,000 pounds to 177,000 pounds. The second option is almost the same but is partially reusable and the payload capacity is 72,000 pounds to 110,000 pounds. With UTC's partially recoverable ALS mode, the core vehicle reaches orbit and the payload is deployed. The core vehicle and the P/A module separate and the core tankage disintegrates and burns up as it reenters. The P/A module recovery system is activated and the P/A module reenters and is parachuted back to its designated landing site. At both the ETR and WTR, landing sites must be relatively level, at least six square miles in diameter, and capable of supporting the P/A module and its transporter. The third option incorporates the liquid flyback booster concept with fixed wings. The major expendable flight elements are the core vehicle tanks and cargo shroud.

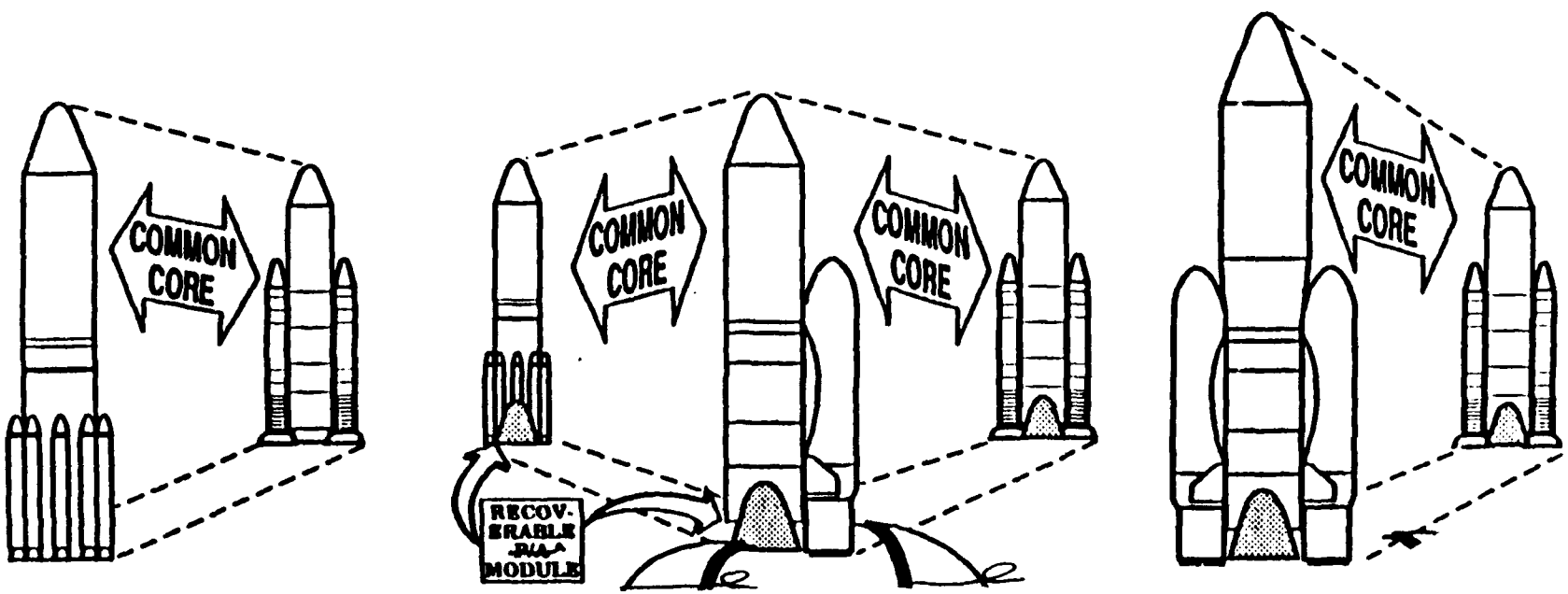


Figure 2.13

UNITED TECHNOLOGIES CORPORATION VEHICLE CONCEPT

Operational Concept

UTC's operations consist of on-site horizontal manufacture and assembly with vertical integration. In order to meet the normal mission launch requirements, the booster stage and the P/A module for the core vehicle will be assembled at the ETR and transported on a barge to the launch site at the WTR via the Panama Canal.

Launch Sites

Florida

Two ALS launch pads are proposed at CCAFS near abandoned launch complexes 14 and 15. New facilities, roads, bridges, and propellant storage sites would be required.

California

Two ALS launch pads are proposed at VAFB, southeast of SLC-6 and the proposed SLC-7. New facilities, roads, bridges, culvert crossings, railroad and new propellant storage sites would be required. Large vehicular and logistics elements would require water transportation via barge from the ETR through the Panama Canal.

2.3 ASSUMPTIONS FOR PRELIMINARY ENVIRONMENTAL CONSTRAINTS SURVEY

The five proposals differ in the level of detail given for the systems that are being proposed. Information used in the preliminary environmental constraints survey includes such things as specific locations where the impacts will occur (exact siting of facilities); how many people will be required to construct and operate the system; how much money will be spent in the local economy during construction and operation; and how much water, power, concrete, aggregate, steel, etc. will be required. Some of the candidate concepts and proposals have fairly detailed information for some of these areas but are lacking in others. Other proposals took a more general approach to defining the systems at this point in the MSAP and are lacking in much of the detailed information. For this reason, the analyses in this document are based on a basic set of assumptions which are a consolidation of the best available information from all five proposals. These assumptions deal primarily with the major project factors which are used to determine the type and extent of environmental constraints.

Estimates of land area required for facilities were prepared for each of the five contractors (Table 2.5). These estimates were based on available information and the assumption that similar facilities would be required. They are, however, only to estimate relative areas among the five proposals.

Following a review of the five basic candidate ALS concepts, and the various options included within them, potential environmental issues were identified and categorized within several broad areas of environmental concerns, including: geology, air resources, water resources, biological resources, cultural resources, visual resources, land use, socioeconomics, health and safety, and hazardous waste.

Due to the broad and yet complex nature of the candidate concepts, and the variable nature of the information on the launch sites, the resource areas evaluated include sub-units that will be addressed in detail in future NEPA compliance documents. At that time, site-specific environmental documentation will be based on more detailed engineering and design of the ALS concepts.

Table 2.5. Average Facilities Requirements for Each Candidate Concept

	FACILITIES					
Contractors	Total # Acres Disturbed by Facilities	Total # of Facilities	Build New or Modify Facilities	Miles of Road (New or Modify)	Miles of Railroad (New or Modify?)	Harbor Facilities New or Modified at WTR
Boeing	38 Acres (facilities only) 4020 acres P/A model landing site (ETR only)	22	20 new 2 mod	4.7 miles (new) crawlerway	12.42 (new)	Solid boosters and possibly large core vehicle components will have to be brought in via barge. VAFB harbor will have to be maintained and dredged each time.
General Dynamics	28 Acres (+7)	13 (+7)	Mostly new	Not given	5.5 miles (new)	Same as Boeing except SRBs transported by rail
MMC/MD	91 acres (+7) at ETR, WTR, & HI	11 (+7)	Mostly new	20 miles	1 mile	For offshore option a large harbor facility will be required. Otherwise same as Boeing.
Rockwell	38 acres (+7) at ETR & HI 9 acres (+7) at WTR	8 (+7) at ETR; 7 (+7) at WTR	Mostly new	Not given	Not given	Same as Boeing
UTC	24 acres (+7)	8 (+7)	Mostly new	20 miles at WTR 1 mile at ETR (new)	Not given	Same as Boeing

Note: The added numbers in parenthesis are facilities listed and sized by Boeing which were not discussed by the other contractors. Since all these facilities will be required they are added in here to make the comparisons more equivalent. The facilities are: a crawler park (2.75 acres), gaseous Nitrogen and Helium tank farms (>1 acre each), and four storage areas for hypergolic fuels (20,000 square feet each). These data are estimates of values that represent each of the three locations: WTR, ETR, and the Hawaii option, unless otherwise noted.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.0 EXISTING CONDITIONS AND ENVIRONMENTAL CONSEQUENCES

3.1 GEOLOGY AND SOILS

3.1.1 Affected Environment

3.1.1.1 West Coast

VAFB is situated in the middle of the 400-square mile Santa Maria physiographic district. The surface topography of VAFB is quite varied. The highest topographic relief is in the northern (Casmalia Hills) and southern (Santa Ynez Mountains) parts of the base; the central portion consists of a large mesa and terrace, dissected by San Antonio Creek and the Santa Ynez River. Lompoc Terrace is on the south side of Lompoc Valley and has an average elevation of 250 feet. San Antonio terrace, Burton Mesa, and the Lompoc Terrace are prominent erosional platforms that formed during a period of variable sea level in the Middle and Late Pleistocene (900,000 to 10,000 years before present). Each terrace is actually composed of a series of smaller terraces that were cut during this time period and are now partially to entirely covered by vegetation and recent soil development.

Further to the south, there are several canyons which have extensively dissected Lompoc Terrace and the slopes of the western Santa Ynez Mountains. These include La Salle and Lompoc Canyons which drain to the north into the Santa Ynez River, and Bear Creek, Spring Canyon, La Honda Canyon, Gray Canyon, and Red Roof Canyon which generally drain to the west into the ocean. The west-trending drainages in particular may follow pre-existing faults. Tranquillon Ridge and Mountain form the dramatic western terminus of the Santa Ynez Mountains, where they plunge into the ocean. Elevations in the Santa Ynez Mountains are commonly greater than 2000 feet within a couple of miles of the coast. Both the north and south slopes are very steep, in particular the south, which are cut by 12 canyons before Jalama is reached, at the southern end of VAFB.

3.1.1.2 East Coast

The Florida peninsula is a part of a feature known as the Florida Plateau. The plateau is made up of a complex of limestone and dolomite several thousand feet thick. Sea levels, which have fluctuated over geologic time have resulted in cycles of excavation and erosion followed by alluviation and deposition.

The upper formation of the complexes make up the Floridian aquifer. These formations, from the oldest to the youngest, are the Avon Park and Ocala. The confining beds of the Hawthorn Formation overlie the Floridian aquifer. The modern beach strand and relict inland dunes result from aeolean drift of quartz sands found on higher terraces.

Soils in the study area are derived from relict beach ridges, which have been formed by wind and wave action. The ridges have been eroded, forming the soils and marine estuary environment. The soils are generally highly permeable, fine-grained sediments typical of beach and dune deposits. The soil associations have been identified by the U.S. Department of Agriculture Soil Conservation Service (1974).

Refraction surveys and well log investigations conducted by the U.S. Coast and Geologic Survey show that the underground structure of ETR is normal and free of voids or anomalies. Earthquakes are not considered a hazard in the southeastern central states (NASA 1986).

3.1.1.3 Hawaii

The island of Hawaii is located on the southeastern end of a 1600-mile long chain of volcanic islands stretching across the North Pacific Ocean. Hawaii is the largest and youngest of the main Hawaiian island chain. It rises over 30,000 feet from the sea floor to the summits of Mauna Loa and Kilauea volcanoes. Both are shield volcanoes, having a broad summit and base. The southeastern flanks of the volcanoes are riddled with active faults that, during periods of subsurface magnetic movement, can cause significant local earthquakes. Both volcanoes have been active throughout the past 200 years. Kilauea is located on the southwest rift zone of the island and over the past 30 years has been the more active of the two. It has been under almost continuous eruption since January 1983, adding several acres per week to the island's coastal area. There is no evidence that this eruptive phase will cease in the near term.

3.1.2 Environmental Consequences

Potential geologic constraints include:

- o erosion resulting from changes in landform, and the discharge of treated deluge water to grade;

- o landslides;
- o seismic issues in California and Hawaii;
- o inundation by Tsunami.

Boeing

Sand Dunes

Sand dunes are noticeable features along the coastal strip on VAFB, in particular on San Antonio Terrace where they are approximately 12 square miles in size. These dunes are quite prominent and extend inland as far as four miles. The Boeing proposal states that a six square mile landing area would be created by grading the sand dunes flat on San Antonio Terrace. The destruction of this geologic landform would constitute a high geologic constraint. It would not be possible to permanently stabilize an area of sand this size due to the effect from wind and water erosion.

Landslide Areas

The western slopes of the Santa Ynez Mountains on South Vandenberg, where the topography is very steep, and is subject to landslides. Landslides could possibly pose a significant constraint if launch pads or support facility sites are cut into the steep slopes which surround the Sudden Flats area.

Soil Erosion

The South Vandenberg area has not been mapped by the Soil Conservation Service to date; therefore, the problems associated with soil erosion is not precisely known. Field tours of the area, however, indicate that erosion and gullying continues to be a problem around SLC-6 and its facilities. It is believed that this problem would occur elsewhere on Sudden Flats, and is of particular concern when construction is located on or adjacent to the shoreline cliffs.

Seismicity/Strong Ground Motion

Major earthquakes have been recorded in Santa Barbara County since the late 1700's. The recurrence intervals for major quakes of magnitude 5.2 to 7.0 are 14 to 115 years (Thenhaus et al. 1980). VAFB, though located in an earthquake-prone

area, has not had any reported damage to its facilities. Strong ground motion could occur on VAFB from earthquakes on active faults situated in the Santa Barbara Channel, along the Hosgri fault system offshore of the Santa Maria basin, and along the San Andreas fault system. The U.S. Geological Survey estimates that this area may be subjected to ground accelerations of between 20 percent and 30 percent of gravity in a 2500 year period (Thenhaus et al. 1980).

The California Division of Mines and Geology (1981) has preliminarily determined that the VAFB area could receive a maximum earthquake intensity between VII and IX on the Modified Mercalli Intensity scale. Earthquakes with intensities of VII to VIII would be felt by all people and damage would probably range from moderate to considerable in well-built structures. Earthquakes of IX intensity would destroy most masonry and frame structures.

Surface Fault Rupture

The potential for surface fault rupture is considered to be low on VAFB, even though this is in the midst of a transition zone from offshore fault systems to onshore fault systems. The onshore faults are numerous, extending to the southeast across the base, and form a highly complex structural geologic setting. Any known fault in this area should be considered potentially active. Movement at the surface could be in the form of a few centimeters, to a foot, to no movement at all, depending on the intensity and the epicenter of the quake.

Tsunami Inundation Area

The size and extent of a Tsunami is dependent on the magnitude of the event, the distance from the sources, the local sea floor topography, and the coastal zone topography (Santa Barbara County Seismic Safety Element, 1979). VAFB has been affected by only a few local and a few distant earthquake-generated tsunamis. The 1927 Lompoc earthquake located west of Point Arguello produced a six-foot wave which inundated the coasts of Santa Barbara and San Luis Obispo counties. The 1964 8.4 magnitude Alaskan earthquake generated a tsunami which was measured in San Luis Obispo County at 10.4 feet in height. The hazard of tsunamis is considered for this area to be very low. Only those facilities exposed generally less than 40 feet above sea level could conceivably be inundated by a sea wave run-in and draw-back.

Martin Marietta Corporation/McDonnell Douglas

The same geologic constraints and geologic hazards discussed above apply to the Martin Marietta Corporation/McDonnell Douglas proposal at VAFB, except that sand dunes will not be affected by this proposal.

Rockwell

The same geologic constraints and geologic hazards discussed above apply to the Rockwell proposal at VAFB, except that sand dunes will not be affected by this proposal.

General Dynamics

There are two geologic constraints which are unique to the General Dynamics proposal and are discussed below. The sand dunes will not be affected by this proposal.

The expansion and construction of a two-lane road from Lompoc to Sudden Flats, across the crest of the western Santa Ynez Mountains will pose severe landslide and erosion hazards. VAFB has had difficulty maintaining the existing two-lane road network through the Santa Ynez Mountains. The steep topographic relief creates situation where landslides and erosion commonly occur.

The relcoation of the Southern Pacific Railroad off VAFB would also create severe geologic constraints due to the steep topography associated with the Santa Ynez Mountains. This would require a major civil engineering undertaking to construct such a route through the core of these mountains.

United Technologies Corporation

The same geologic constraints and geologic hazards discussed above at VAFB, under the Boeing proposal heading, apply to the United Technologies Corporation proposal.

3.1.2.2 East Coast

In general, there will be only limited impacts resulting from the various ALS concepts. There are, however, incremental differences between the concepts depending on whether existing or new facilities are proposed and whether deluge water is recycled or is disposed of on the ground surface.

Boeing

Boeing is proposing two actions which could result in significant geological/soils impacts. The six-square mile P/A module launching area will require significant movement of soils, and they propose surface discharge for disposal of treated deluge water. The amount could be as much as 850,000 gallons/launch. Thus, disposal could result in erosion problems unless it is handled in a manner which would permit percolation into the underlying structures.

General Dynamics

General Dynamics is proposing use of existing launch facilities at the LC 37 and LC 34 pad sites. They will require new infrastructure items as well as facilities for vehicle processing. Construction of the new facilities and infrastructure will result in impacts to the soil structure.

Martin Marietta Corporation/McDonnell Douglas

MMC/MD's concept calls for new launch pads, new facilities for processing, port facilities and launch control center. This new construction will require alteration of the soils, resulting in impacts to the soil structure.

Rockwell

Rockwell's concept calls for construction of new launch pads and construction of new facilities and infrastructure. Due to the proposed location of one launch pad in a marsh, it is assumed that soil and subsurface alterations will be required to provide stable launch pad. The new construction will result in impacts to the soil structure through dredging and filling.

United Technologies Corporation

UTC proposes to use facilities near old launch complex CD 14 and 15. New assembly facilities, as well as infrastructure will be required. Since the concept has a returnable P/A module there is a requirement for a landing site. It is assumed that it will also, as with the Boeing concept, reacquire an area of six-square mile be graded flat to facilitate recovery.

This alteration could result in significant land form changes. It may also result in simultaneous changes in the rainwater run-off flow with possible erosion occurring.

3.1.2.3 Hawaii

Martin Marietta Corporation/McDonnell Douglas

Soil Erosion

There is poor to no soil development throughout the southeastern part of the island of Hawaii. Wind erosion could occur in these areas when disturbed due to the lack of vegetative cover.

Seismicity/Strong Ground Motion

Seismicity associated with volcanic activity is a common phenomenon to southeastern Hawaii. Mild earth tremors usually occur in this area as bodies of magma migrate through subterranean networks of tubes. The probability of a large magnitude earthquake occurring on the island is very low because of the type of basaltic lava that is extruded.

Surface Fault Rupture

Many fissures and cracks have been mapped throughout the Palima Point area (A.D. Little, 1988). These cracks could move during a mild earthquake, becoming active faults, and cause damage to adjacent structures.

Tsunami Inundation Areas

The Hawaiian Islands have been struck by 96 tsunamis in the last 165 years. A tsunami warning system is in place to warn coastal dwellers when a wave is approaching. Land use zoning of coastal areas is based on the heights of tsunami waves expected for exposure times of 20-, 50-, and 100-years. The greatest threat from incoming tsunamis on the southeast coast of Hawaii is from submarine earthquakes generated either locally or off the west coast of South America.

All of the proposed onshore facilities lie within tsunami hazard zone Number Four: earthquake-generated waves between 30 and 50 feet could inundate this coastal area (Hays, 1981). There is a ten percent chance that these wave heights could be exceeded within a 50-year period.

Basaltic Lava Flows

The majority of the area for proposed onshore facilities lie within volcanic hazard zone two, number one having the highest potential of volcanic activity (Telling, et al. 1987). Lava flows from the Kilauea volcano frequently inundate the area a few miles north of Palima Point. The large system of cracks and fissures which are common in the southeastern part of the island could be future sites of volcanic activity. There is no way to predict the areal coverage of the lava activity. Palima Point is located on the southwest rift zone of Kilauea.

Rockwell

The same geologic constraints and geologic hazards discussed above apply to the Rockwell proposal at Palima Point.

3.2 WATER RESOURCES

3.2.1 Affected Environment

3.2.1.1 West Coast

3.2.1.1.1 Water Availability and Use

Surface water supplies on VAFB are extremely limited and are fully utilized at present. VAFB crosses two major watersheds of Santa Barbara County: the San Antonio Creek and the Santa Ynez River basins. Although these water basins are extensive, they receive very low precipitation and most water courses are ephemeral, i.e., water flows in their channels only during and shortly after storms. San Antonio Creek drains an area of 154 square miles and has a mean annual discharge of 4.6 cubic feet per second (CFS), or 3,330 acre-feet per year (AFY), with extensive periods of no flow occurring most of each year (USGS 1983). Peak water flows are approximately 1000 CFS. The U.S. Army Corps of Engineers estimate the 100-year flood to be 118,000 CFS. The Santa Ynez River, which drains an area of about 900 square miles, is regulated by three reservoirs for municipal use in the Santa Barbara area. Peak flows are between 20-200 CFS. The U.S. Army Corps of Engineers estimates the 100-year flood to be 9,000 CFS (O'Brien, 1981).

In addition, five small lakes on VAFB provide slightly over 200 AF of surface water storage with a total surface area of 27.3 acres. Because surface water supplies are limited by seasonal stream flows and are of poor water quality, the base does not presently use water from surface supplies.

Surface water quality at VAFB is generally poor, with high concentrations of sodium, chloride, iron, aluminum, and total dissolved solids (TDS). A 1983 study of San Antonio Creek found TDS ranging from about 900 to 3,600 parts per million (PPM) and increased concentrations of sodium, chloride, and sulfate (USAF 1986a). TDS in the Santa Ynez River within VAFB ranged from 602 to 1,180 ppm during 1983. Groundwater quality varies significantly from aquifer to aquifer. The aquifer under the Lompoc Terrace produces potable water, while the aquifer at SLC-4 is high in TDS.

VAFB withdraws water from three groundwater basins -- the San Antonio basin and the Santa Ynez basin supplies north VAFB, and the Lompoc Terrace area in South Vandenberg within the Santa Ynez watershed supplies south VAFB. These basins meet all of the base's water supply needs. However,

increased withdrawals by off-base agricultural, industrial, and domestic users have created overdraft conditions which lower water availability and quality in all three basins.

The San Antonio basin, contained mostly within the San Antonio Creek Valley, has an estimated working storage capacity of 500,000 AF (DWR 1985). Dames and Moore (1985) reported the safe yield of the San Antonio groundwater basin to be 8,000 AFY. Current pumpage from the basin includes 34,000 AFY for use on VAFB from a well field just north of Barka Slough (USAF 1986a), 290 AFY for municipal and industrial uses mostly in the town of Los Alamos, and about 16,000 AFY for off-base agriculture (Dames and Moore 1985). Current pumpage exceeds the estimated safe yield of the groundwater basin by more than 11,000 AFY. At this rate, the groundwater reservoir will be depleted in approximately 50 years (ICFT 1987).

South VAFB draws groundwater from three interconnected basins that make up the lower half of the Santa Ynez groundwater basin. Together, these three basins provide a total working storage capacity of 300,000 AF with a safe yield estimated at 33,000 AFY. Pumpage currently exceeds the estimated safe yield of these basins by about 4,600 AFY. In a study for VAFB, Earth Sciences Associates (1982) projected that water use in the Lompoc-Santa Maria area will increase by over 13,000 AFY by the year 2000, with an additional increase of approximately 2,700 AFY for VAFB.

3.2.1.2 East Coast

Surface water in the ETR includes portions of the Indian River, the Banana River, Mosquito Lagoon, and all of Banana Creek. These water bodies are shallow except for portions maintained as part of the Intracoastal Waterway. In general, the surface waters of the area are best described as shallow estuarine lagoons.

In compliance with the Clean Water Act (CWA), surface waters have been classified by the State of Florida. Mosquito Lagoon and the northern segment of the Indian River are designated as Class II areas (shellfish propagation and harvesting). Class II waters establish more stringent limitation of bacteriological and fluoride pollution, and the discharge of treated wastewater effluent is prohibited. The remaining surface water areas are designated as Class III (recreation, propagation and management of fish and wildlife). Class II standards are intended to maintain

water quality suitable for body-contact sports and recreation, and the production of diverse fish and wildlife communities.

The surface waters adjacent to Merritt Island National Wildlife Refuge (MINWR) have been designated as an Outstanding Florida Waters (OFW). OFW's establishes the primary water quality standards for regulatory purposes. This level of protection prohibits any activity which would reduce water quality below existing levels.

Surface water quality in the area is generally good. NASA and the CCAFS maintain water quality sampling stations throughout their management areas to determine physical and chemical characteristics. These include: temperature, dissolved oxygen, nutrients, heavy metals, and pesticides. The water quality sampling program is intended to identify potential sources of pollutants which contributes to surface water degradation., The U.S. Fish and Wildlife Service (USFWS) monitors salinity, dissolved oxygen, Ph, and water levels at 78 locations in the area.

Water quality within Mosquito Lagoon is mostly unaffected by human sources. The lack of significant upland drainage basin and the absence of point and non-point discharges may account for the high salinities in this water body.

The Indian River surface water quality is more likely to be influenced by the City of Titusville than KSC and CCAFS. Quality of the Banana Creek is influenced by non-point source run-off from the Space Shuttle Landing Facility, the VAB area, the Kennedy Parkway, and from undeveloped areas. Banana Creek experiences regular fish kills when shallow waters are warmed to high temperatures and when extensive cloud cover reduces the dissolved oxygen levels.

The Banana River segment within the ETR is influenced by KSC as well as CCAFS. Several facilities provide run-off to the northern segment resulting in lower salinities. Point Source discharges from KSC and CCAFS influence the Banana River southern segment. Efforts are underway to eliminate discharges from a secondary treatment plant at KSC. At CCAFS a secondary treatment plant discharges, via canal, to the Banana River. Despite potentially significant point and non-point sources, water quality within the Banana River segment is good.

Groundwater in the ETR area occurs in confined (artesian) and unconfined (non-artesian) conditions. Confined groundwater is located in the Floridian aquifer, which serves as the primary groundwater source in coastal lowlands.

The State of Florida adopted water quality standards for groundwater in 1983. There are four classes, but all of Florida's groundwater aquifers are either G-II or G-III. G-II is potable groundwater in aquifers with Total Dissolved Solids (TDS) content less than 10,000 mg/1. Class III is non-potable groundwater with TDS greater than 10,000 mg/1.

The Floridian Aquifer is made up of limestone formation several thousand feet thick. Recharge occurs mainly in northern and central Florida. Because of confining clays of the Hawthorne Formation and artesian conditions, potential contamination of this aquifer in the ETR is limited.

The water in the Floridian Aquifer, although of good quality in other regions, is highly mineralized in the ETR and is not used for commercial or domestic purposes. Brevard County Water Study ranked the Floridian Aquifer beneath KSC as having low potential for acceptability. Potable water comes from the unconfined aquifer. This shallow aquifer is composed of recent and Pleistocene Age deposits. The unconfined aquifer formation ranges in depth from approximately 20 feet to 50 feet. Recharge primarily comes from the direct infiltration of precipitation. The surficial aquifer has maintained freshwater classification due to immediate recharge, active flushing, and a lack of development. Although it is of good quality it is susceptible to contamination. Neither on-site surface or groundwater are used at the ETR. Currently water is supplied to KSC and CCAFS through an agreement with the City of Cocoa Beach to supply up to 9 million gallons a day (MGD). The source of this water is well fields tens of miles away from the ETR. KSC is using 0.75 MGD and the Air Force is using 2.9 MGD which totals to 3.65 MGD, thereby leaving a capacity of 6.35 MGD available.

3.2.1.3 Hawaii

Basal groundwater (freshwater floating on salt water) is the predominant source of potable water for Hawaii's southeastern coast. Several large coastal springs in the area discharge more than 35 million gallons per day (MGD), or 39,235 AFY (ADL 1987). The Pahala Water System, operated by the Hawaii Department of Water Supply, provides the

Palima Point area with up to 1.2 MGD, or 1,350 AFY. Total consumption from the Pahala system is currently 450 AFY, with excess capability of 900 AFY. This excess water is often sold to agricultural users or transferred to neighboring water supply systems as needed.

The chemical quality of Hawaii's surface waters and groundwaters is generally excellent upstream of urban areas, with less than 100 PPM TDS and Ph ranges between 6.0 and 8.0 (USGS 1985). However, the potential for water supply contamination from raw sewage, agricultural wastes, and run-off is great. Raw sewage is often dumped into private cesspools or directly into coastal waters or rivers, contributing to the pollution of coastal waters and threatening potable groundwater supplies. Agriculture in the project area generally protects the soil from severe erosion and run-off during the wet season; sugar mills release chemicals and processing wastes directly into coastal waters and may threaten groundwater resources.

Flood hazards are minor along Hawaii's southeastern coast. The Palima Point area receives between 20 and 40 inches of rainfall annually (Rockwell 1988). Most of this water is absorbed into the highly permeable lava soil, recharging the basal groundwater supply. The area slopes seaward at approximately a 3-percent grade, and ephemeral streams drain excess rainfall into the ocean. There are no major surface-water drainages in the area.

3.2.2 Environmental Consequences

Potential sources of water contamination include:

- Discharge of deluge water from the catchment basin to grade within the launch complex facility prior to treatment;
- Propellant leaks on the launch pad or in storage;
- Leaching of heavy metals from paint chips during refurbishing existing facilities;
- Discharge of deluge waters during near or off-shore launches.

3.2.2.1 West Coast

Boeing

Water Availability and Use -- An estimated 1 million gallons of water will be needed for each ALS launch for sound suppression and pad washdown. Assuming an average of 50 launches per year, the deluge requirement is 50 million gallons per year, or 150 AFY. Fresh water (not brackish or sea water) will be used for each launch and will not be recycled or reused. Half of the deluge water is expected to evaporate at launch, leaving 500,000 gallons to be recovered for treatment and disposal after each launch.

The peak-year population impact is estimated at 13,230 people (5,292 direct and indirect workers plus families; see Section 3.9, Socioeconomics). At an average consumption rate of 100 gallons per day per person, these people would use approximately 1,450 AFY of potable water (ICFT 1987). Thus, the total demand for potable water for ALS-related activities at VAFB is approximately 1,600 AFY.

Given that VAFB and surrounding agricultural areas currently use all available potable water, and overdraft conditions exist at all aquifers on and near VAFB, a further drawdown of 1,600 AFY would have significant impacts on groundwater supplies and surface flows. In addition, future growth in the area and planned oil development at VAFB will aggravate the existing shortage of potable water. Therefore, water availability is a high constraint.

Water Quality

Deluge water is the major potential source of water contamination associated with ALS. During launch, the sound suppression water will pick up hydrogen chloride (HCl) from the SRB exhaust, slightly lowering its pH. After launch, the pad washdown water will pick up a wide range of metals (aluminum, barium, cadmium, chromium, copper, iron, nickel, lead, tin, zinc) from the exhaust residue and protective coatings off of launch structures (USAF 1986b). ICF Technology (1987) has projected that the ALS program will generate approximately 1.6 million gallons of waste water and 7,400 pounds of solid wastes per launch. Approximately 93.5 percent of the waste water will be deluge water. All deluge and washdown water must be collected and treated before disposal. A wastewater treatment facility with a 1 MGD capacity was built at SLC-6 to treat waste waters from

Space Shuttle operations. Evaporation ponds associated with the treatment plant are permitted at a 500,000 gallon capacity.

Other potential impacts on water quality are deluge spills or leaks; the exhaust plume and other toxic gas releases; and fires or explosions. These impacts would be minimized through chemical-containment techniques. Since Boeing proposes to modify existing facilities at SLC-6 for ALS operations, further construction would have significant effects on soil erosion and surface water run-off, and thus moderate impacts on water quality.

Flood Hazards

Flood hazards are minor in the vicinity of SLC-6, which lies above the Santa Ynez River floodplain.

General Dynamics

The same constraints on water availability and use, water quality, and flood hazards apply as described above for Boeing. General Dynamics proposes to build new facilities at the Sudden Flats area east of SLC-6. This new construction would increase the potential for water quality impacts from soil erosion and run-off. Flood hazards are minor in the vicinity of Sudden Flats, which lies above the Santa Ynez River floodplain.

Martin Marietta Corporation/McDonnell Douglas

The same constraints on water availability and use, water quality, and flood hazards apply for MMC/MD as described above for Boeing. Construction of proposed new facilities at the Sudden Flats area east of SLC-6 would increase the potential for water quality impacts from soil erosion and run-off. In addition, proposed off-shore and near-shore launches at VAFB and Port Hueneme pose additional constraints by increasing the potential for water quality impacts on coastal water from HCl and metals in the exhaust plume, fuel spills during propellant transfers at sea base.

Rockwell

The same constraints on water availability and use, water quality, and flood hazards apply for Rockwell as described above for Boeing. In addition to modifying existing facilities at SLC-6, Rockwell proposes to build new

facilities at the Sudden Flats area east of SLC-6. This new construction would increase the potential for water quality impacts from soil erosion and run-off.

United Technologies Corporation

The same constraints on water availability and use, water quality, and flood hazards apply for United Technologies Corporation as described above for Boeing. Construction of proposed new facilities at the Sudden Flats area east of SLC-6 and in north Vandenberg would increase the potential for water quality impacts from soil erosion and run-off.

3.2.2.2 East Coast

Boeing

Boeing's concept calls for use of existing facilities or construction of new facilities in proximity to launch sites. It is their proposal to collect deluge, move it to storage, whereupon it contaminates will be removed and the water disposed of on-site.

Renovation of existing facilities could result in removal of materials with the potential to contaminate ground and surface waters. Cleaned deluge water released on-site should result in minimal impacts to the water resources.

General Dynamics

General Dynamics' concept calls for upgrade of existing launch facilities with processing taking place at the CCAFS Industrial base. Plans call for deluge water to be recycled. Renovation of existing facilities could result in removal of materials with the potential to contaminate ground and surface waters.

Martin Marietta Corporation/McDonnell Douglas

MMC/MD are proposing new launch pads, manufacturing and integration facilities, off-shore and near-shore launch sites and upgrade of port facilities. Deluge waters from land launches can be treated prior to reuse or disposal. Impacts are related to near- and off-shore launches. Unless deluge water is collected and treated there will be impacts to the water quality in the area of the launch pads which may directly affect the water quality. In off-shore launches

effects on water quality will dissipate the further from the launch site. With a near-shore facility tidal actions could bring pollutants into marshes and other sensitive areas.

Rockwell

Rockwell's concept calls for all new facilities and infrastructures. Deluge water could be collected, treated and re-used. Few impacts to water are anticipated.

United Technologies Corporation

UTC's concept calls for upgrade of existing facilities. Deluge waters will be collected, cleaned and re-used. Renovation of existing facilities could result in removal of materials with the potential to concaminate ground and surface waters.

3.2.2.3 Hawaii

Martin Marietta Corporation/McDonnell Douglas

Water Availability and Use -- An estimated 1 million gallons of water will be needed for each ALS launch for sound suppression and pad washdown. Assuming an average of 50 launches per year, the deluge requirement is 50 million gallons per year, or 150 AFY. Fresh water (*not brackish or* sea water) will be used for each launch and will not be recycled. Half of the deluge water is expected to evaporate at launch, leaving 500,000 gallons to be recovered for treatment and disposal after each launch.

The peak-year population impact is estimated at 3,150 people (1,260 direct and indirect workers plus families; see Section 3.9, Socioeconomics). At an average consumption rate of 100 gallons per day per person, these people would use approximately 350 AFY of potable water (ICFT 1987). Thus, the total demand for potable water for ALS-related activities in Hawaii is approximately 500 AFY.

An on-site well system would need to be developed at Palima Point to supply the required deluge water, plus facility and domestic water needs. Given the abundance of groundwater in the area, ALS water supply requirements pose a low constraint.

Water Quality

Deluge water is the major potential source of water contamination associated with ALS. During launch, the sound suppression water will pick up hydrogen chloride (HCl) from SRB's, slightly lowering its pH. After launch, the pad washdown water will pick up a wide range of metals (aluminum, barium, cadmium, chromium, copper, iron, nickel, lead, tin, zinc) from the exhaust residue (USAF 1986b). ICF Technology (1987) has projected that the ALS program will generate approximately 1.6 million gallons of liquid wastes and 7,400 pounds of solid wastes per launch. Approximately 93.5 percent of the liquid wastes will be deluge water. An on-site wastewater collection, treatment, disposal system would need to be developed with sufficient capacity to handle ALS-related wastewater and to conform with State Department of Health regulations. Hazardous wastes would have to be shipped to the mainland for disposal.

MMC/MD proposes land, near-shore, and off-shore launches. Off-shore launches would increase the potential for water quality impacts on coastal waters from HCl and metals in the exhaust plume.

Other potential impacts on water quality would come from deluge spills or leaks; the exhaust plume and other toxic gas releases; and fires or explosions. These impacts could be controlled using proper safety procedures and chemical-containment techniques. Since no facilities currently exist in the Palima Point area for ALS operations, construction may have significant effects on soil erosion and surface water run-off, and thus on water quality. Given the high potential for contamination of potable groundwater supplies as well s coastal waters, water quality issues pose a moderate constraint on ALS activities in Hawaii.

Flood Hazards

Due to the 3-percent seaward slope of the terrain at Palima Point, and the high permeability of the soil, the potential for flood hazards is low.

Rockwell

For Rockwell's proposed land-based launches, the same description of water availability and use, water quality, and flood hazards apply as described above for MMC/MD.

3.3 AIR QUALITY

3.3.1 Affected Environment

Air quality in a given location is described by the concentration of various pollutants in the atmosphere, which are expressed in units of concentration, generally parts per million (ppm), or micrograms per cubic meter (ug/m^3). The significance of a pollutant concentration is determined by comparing it with an appropriate federal and/or state air quality standard. Air quality in a region can be described by discussing the local climate, baseline pollutant levels, and existing sources of air contaminants.

3.3.1.1 West Coast

The climate in Santa Barbara and Ventura Counties is classified as Mediterranean and is characterized by cool, dry summers and mild, wet winters. The major influence on regional climate is the Eastern Pacific High, a strong persistent anticyclone. Seasonal variations in the position and strength of this system are a major influence in the weather changes in the area. The proximity of the Pacific High, combined with thermal low-pressure in the interior desert region to the east, results in prevailing northwest flow in the region.

The ambient air quality in the region is generally good. Presently, both counties are considered to be in attainment or unclassified for all criteria pollutants, except for ozone (O_3) and particulate matter. An area is considered to be in attainment for a pollutant if the federal primary standard is not exceeded more than once a year. Unclassified areas are generally rural areas in which insufficient monitored data exists to make an attainment determination. The National Ambient Air Quality Standards (NAAQS) are displayed in Appendix 1. The NAAQS are divided into two categories: primary and secondary. Primary standards provide for the protection of the public health and sensitive subgroups. Secondary standards provide for the protection of public welfare from materials soiling, vegetation damage, and visibility impairment. Due to the non-attainment status of the two counties for O_3 and particulate, new projects are subject to New Source Review (NSR) and Prevention of Significant Deterioration (PSD) rules. The requirements for NSR/PSD are discussed in section 3.2.2.

High pollutant impacts of O_3 and ozone precursors may occur when nighttime land breezes transport pollutants from the onshore area over the ocean and return the following morning with the onset of the sea breeze. These pollutants may combine with local emissions onshore, resulting in high pollutant impacts. High O_3 impacts may also occur when a build-up of high pressure inland from Southern California produces warm, dry northeast winds, which transport pollutant-laden air from Los Angeles to the region. High particulate impacts generally result from wind-blown dust which is a by-product of the extensive agriculture in the area.

VAFB is located in a primarily rural setting, distant from major sources of pollutant emissions. Besides the emission sources related to ongoing Air Force activities, the only substantial sources on the base are associated with petroleum exploration and development.

Port Hueneme is located in the vicinity of a primarily urban and agricultural area. Additionally, a small industrial complex, consisting of a power plant, paper mill, and other industrial facilities, is situated to the south of the harbor.

3.3.1.2 East Coast

The climate in Brevard County, Florida is classified as subtropical and is characterized by relatively humid summers and mild winters. Easterly sea breezes prevail during the summer and help to moderate temperatures. During the winter, cooler winds from the northwest prevail, in addition to sea breezes. Temperatures in all seasons are moderated by the waters of the Indian and Banana Rivers and the Atlantic Ocean.

The air quality at CCAFS and KSC is generally good, due to a lack of major air pollution sources in the area. Brevard County is currently in attainment for all criteria pollutants, although neighboring Orange County is non-attainment for ozone. Due to the attainment status of the county, PSD review will be required for compliance with local regulations.

The air quality on CCAFS and KSC is influenced primarily by industrial and private sources of air contaminants outside the complexes. Relatively high pollutant impacts may occur

during periods of thermal inversion, a meteorological phenomenon that limits the dispersion and transport of air pollutants.

3.3.1.3 Hawaii

The climate in Hawaii is classified as tropical, due to its setting in tropical latitudes. Topographical influences, however, cause substantial local variations in temperature and rainfall on each of the islands. Hawaii is located within the belt of northeasterly trade winds generated by the semi-permanent Pacific High to the north. These trade winds prevail for most of the year, especially during the summer months.

The air quality on the island of Hawaii is generally good, due to the lack of major sources of air contaminants and the persistent trade winds which prevent the build-up of pollutants in the atmosphere. The largest source of emissions on the island is the Mauna Kea volcano, which emits substantial quantities of SO_2. The island of Hawaii is currently in attainment for all criteria pollutants, and, as a result, PSD review would be required. The Hawaii Volcanoes National Park, which is between 1.5 and 25 miles from the proposed project sites, has been designated as a Class I area by the Environmental Protection Agency (EPA). Under this designation, allowable PSD increments are substantially smaller and very little degradation of the air quality resource is allowed.

3.3.2 Environmental Consequences

Constraints related to air quality include:

- o construction emissions
- o operating emissions
- o the need for regulatory review.

For purposes of this analysis, it is assumed that support facilities would be powered by the utility grid whenever feasible, in an effort to minimize ALS project emissions and impacts, although it is assumed that there will be a need for a mission-created power station owned by the Government which will be powered by diesel or natural gas.

3.3.2.1 West Coast

Boeing

Land Launch -- The Boeing proposal has been assigned a moderate level of constraint as a consequence of the rigorous regulatory analysis that would be required by the Santa Barbara County Air Pollution Control District (SBCAPCD). A New Source Review (NSR) analysis may be required for construction and operational emissions, due to the non-attainment status of Santa Barbara County. This process may result in a requirement for Best Available Control Technology (BACT), a demonstration of compliance with air quality standards, and emissions tradeoffs for construction and operational emissions. A Prevention of Significant Deterioration (PSD) review would be necessary if emissions are estimated to be above federal de minimus values. Additionally, the use of SRM boosters may require a Health Risk Assessment (HRA) analysis, due to the potential for emissions of air toxics. The use of existing facilities may reduce the quantity of emissions tradeoffs necessary to mitigate construction activities. The SBCAPCD would also require offsets and an environmental review for emissions within the Santa Barbara channel resulting from barge transport of the launch vehicle.

General Dynamics

Land Launch -- Similar to the Boeing concept, the General Dynamics land launch proposal has been assigned moderate constraints as a result of the rigorous regulatory review process that would be required by the SBCAPCD. The regulatory process and requirements would be the same as for the Boeing land launch concept. The proposed railroad relocation would result in additional emissions trade-off requirements.

Martin Marietta Corporation/McDonnell Douglas

Land Launch -- Similar to the Boeing proposal, the Martin Marietta/McDonnell Douglas land launch proposal has been assigned moderate constraints as a result of the rigorous regulatory review process that would be required by the SBCAPCD. The regulatory process would be the same as for the Boeing land launch concept.

Near-Shore Launch -- The Martin Marietta/McDonnell Douglas near-shore proposal has been assigned moderate constraints due to the rigorous regulatory review process that would be

required by the SBCAPCD. The regulatory process would be similar to the land launch option and may require emissions tradeoffs, BACT, compliance verification, and a HRA.

Offshore Launch -- The Martin Marietta/McDonnell Douglas off-shore proposal has been assigned a level of high constraints, due to the regulatory process required by the SBCAPCD and/or Ventura County Air Pollution Control District (VCAPCD). The NSR regulatory process and requirements in Ventura County are very similar to those in Santa Barbara County. Additionally, SBCAPCD and VCAPCD rules require that the support vessels transporting equipment and supplies to the launch platform be considered part of the permitted onshore stationary source. The need to provide emissions tradeoffs for the additional emissions generated by support vessels may severely restrict development of this option. Although the launch platform would be located in federal waters, the SBCAPCD and VCAPCD may require a demonstration of net air quality benefit for the project.

Rockwell

Land Launch -- Similar to the Boeing concept, the Rockwell land launch proposal has been assigned moderate constraints as a result of the rigorous regulatory review process that would be required by the SBCAPCD. The regulatory process and requirements would be the same as for the Boeing land launch concept.

United Technologies Corporation

Land Launch -- Similar to the Boeing, Martin Marietta/McDonnell Douglas, Rockwell, and General Dynamics concepts, the United Technologies Corporation land launch proposal has been assigned moderate constraints as a result of the rigorous regulatory review process that would be required by the SBCAPCD. The regulatory process and requirements would be the same as for the Boeing land launch concept.

3.3.2.2 East Coast

Boeing

Land Launch -- The Boeing Proposal has been assigned a low level of constraint as a result of the less stringent regulatory analysis required by the Florida Department of Environmental Resources (FDER) in an attainment area. The regulatory analysis may require Prevention of Significant

Deterioration (PSD) analyses for emissions from operational support activity if the estimated project emissions are above federal de minimus levels. This process may result in the requirement for BACT and a demonstration of compliance with air quality standards. The FDER does not regulate emissions that result from construction activities. The use of SRM boosters may require a HRA, due to the potential for emissions of air toxics.

General Dynamics

Land Launch -- The General Dynamics proposal has been assigned a low level of constraint as a result of the less stringent regulatory analysis required by the FDER for an attainment area. The regulatory process and requirements are the same as for the Boeing land launch concept.

Martin Marietta Corporation/McDonnell Douglas

Land Launch -- The MMC/MD proposal has been assigned a low level of constraint as a result of the less stringent regulatory analysis required by the FDER for an attainment area. The regulatory process and requirements are the same as for the Boeing land launch concept.

Near-Shore Launch -- The Martin Marietta/McDonnell Douglas proposal has been assigned a low level of constraint due to the less stringent regulatory analysis required by the FDER in an attainment area . The regulatory process and requirements are the same as for the Boeing land launch concept.

Offshore Launch -- The Martin Marietta/McDonnell Douglas proposal has been assigned a low level of constraint due to the less stringent regulatory analysis required by the FDER in an attainment area . The regulatory process and requirements are the same as for the Boeing land launch concept. The FDER does not regulate emissions from marine vessels associated with permitted projects.

Rockwell

Land Launch -- The Rockwell proposal has been assigned a low level of constraint as a result of the less stringent regulatory analysis required by the FDER for an attainment area. The regulatory process and requirements are the same as for the Boeing land launch concept.

United Technologies Corporation

Land Launch -- The United Technologies Corporation proposal has been assigned a low level of constraint as a result of the less stringent regulatory analysis required by the FDER for an attainment area. The regulatory process and requirements are the same as for the Boeing land launch concept.

3.3.2.3 Hawaii

Martin Marietta Corporation/McDonnell Douglas

Land Launch -- The Martin Marietta/McDonnell Douglas proposal has been assigned a high level of constraint, as a result of the regulatory analysis required by the Hawaii State Air Pollution Project Office (APPO) for a project in very close proximity (1.5 miles) to a Class I area. The regulatory review may require PSD review if operational support activity emissions are determined to be above federal de minimus values. This process may result in the requirement for BACT and a demonstration of compliance with air quality standards and the more stringent Class I PSD increments. The APPO does not regulate emissions that result from construction activities, with the exception of fugitive particulate matter. The use of SRM boosters may require a HRA, due to the potential for emissions of air toxics.

Offshore Launch -- The Martin Marietta/McDonnell Douglas proposal has been assigned a high level of constraint due to the regulatory analysis required by the APPO for a project in very close proximity (1.5 miles) to a Class I area. The regulatory process and requirements are the same as for the MMC/MD land launch concept. The APPO does not regulate emissions from marine support vessels.

Rockwell

Land Launch -- The Rockwell proposal has been assigned a high level of constraint due to the regulatory analysis required by the APPO for a project in close proximity (1.5 miles) to a Class I area. The regulatory process and requirements are the same as for the MMC/MD land launch concept.

3.4 BIOLOGICAL RESOURCES

3.4.1 Affected Environment

3.4.1.1 West Coast

Vandenberg AFB, the Point Conception area, and the northern Channel Islands (San Miguel, Santa Rosa, Santa Cruz, and Anacapa) contain a diversity of biological resources, including a number of state and federally listed threatened or endangered species, species that are candidates for listing or of special concern due to rarity, and biologically important habitats (sensitive to disturbance, unusual, or highly productive). These resources on VAFB have been summarized and mapped (where data were available) in a recent Mineral Resource Management Plan for the base (USAF 1987). Important biological resources in the Point Conception area and on the Channel Islands have been described in considerable detail in a number of environmental documents (ADL 1985; Howald et al. 1985; MBC 1984 and 1985; Thompson 1984; Kinetic Laboratories 1986; Mulroy et al. 1984).

The following is a brief summary of the biological resources that could pose constraints on siting the proposed ALS program on VAFB. Table 3.4-1 (Appendix 1) lists these resources, the level of constraint, and general locations.

- Federally Listed Threatened or Endangered Species. At least seven species occur in the area that could be affected by the ALS program; American peregrine falcon, California brown pelican, California least tern, southern sea otter, gray whale, Guadalupe fur seal, and unarmored threespine stickleback. The fur seal and sea otter are listed as threatened while the other species are listed as endangered under the federal Endangered Species Act.

- Wetlands. A variety of wetlands are present on VAFB including intermittent and perennial streams, ponds, marshes, and the Santa Ynez River. These are protected under Executive Order 11990 and section 404 of the Clean Water Act.

- Ecologically Important Habitats. Sensitive or unusual plant communities present include riparian and oak woodlands, burton Mesa Chaparral, Bishop pine and tanbark oak forests, coastal dunes, and

coastal bluff scrub. Important animal habitats are monarch butterfly winter roosts, seabird nest sites, and marine mammal haulouts and rookeries. Seabirds are protected under the Migratory Bird Treaty Act while marine mammals are protected under the Marine Mammal Protection Act. Intertidal and subtidal rocky reefs are ecologically important for their high biological productivity, as are kelp beds which often grow on subtidal reefs. The kelp is also commercially harvested. A National Marine Sanctuary surrounds the northern Channel Islands, and the islands are state-designated Areas of Special Biological Significance.

- Other Resources. Coastal and offshore areas near VAFB and the Channel Islands contain productive commercial fishing grounds that are fished throughout the year as weather and open seasons permit. A wide variety of species (e.g., abalone, lobster, crab, fish, shrimp, and sharks) are taken using trawls, traps, diving, set and drift nets, hook and line, and round haul gear. Several mariculture operations are also present.

3.4.1.2 East Coast

CCAFS and KSC lie in the Subtropical Division, Outer Coastal Plain Forest Province (Baily 1978) and include a wide variety of aquatic and terrestrial coastal plain habitats. Plant associations/wildlife habitat cover 11,977 acres on CCAFS and 65,659 acres on KSC, not including acreage planted to citrus groves (2500 acres-KSC), ruderal acreage (1124 acres-KSC), and KSC ponds, borrow pits, completely flooded mosquito-control impoundments, and other water bodies (USAF-ESMC 1984; NASA 1986). These plant association/ wildlife habitats are representative of barrier island resources of the Florida coastal region.

For convenience, the biological resources are discussed as the terrestrial habitats, aquatic habitats, wildlife, fisheries, and threatened or endangered species extant within the Eastern Test Range. Detailed descriptions of these resources are presented in the CCAFS Fish and Wildlife Management Plan (USAF-ESMC 1984) and the Environmental Resources Document (NASA 1986).

Terrestrial habitats containing approximately 1100 plant species include coastal, upland and wetland plant communities as follows:

- o Coastal - Salt spray zone. This consists of two coastal types, the coastal dunes and coastal strand; and six upland communities: oak scrub, Saw Palmetto scrub, slash pine flatwoods, cabbage palm hammocks, oak-cabbage palm hammock and xeric oak hammock.

- o Wetland communities occur in either freshwater and brackish water or saline. These consist of hardwood, willow swamp, freshwater swale marsh, coastal marsh, cabbage palm Savannah, land cordgrass-black rush, mixed salt-tolerant grasses marsh, sea oxeye, saltwort-glaswort, saltmarsh cordgrass, and mangrove.

- o Ruderal vegetation dominate sites disturbed by or created by human activity. These include Brazilian pepper, Australian pine, wax myrtle, melaleuca, and citrus grove.

- o Significant animal habitats include wetlands which rovide feeding, roosting and nesting habitat for 300 species of birds; including southern bald eagles.

- o Seventy species of wildlife present at CCAFS/KSC are protected or proposed for protection by federal, state, and international agencies. Sixty-two species of plants are listed and all of these are of regulatory concern. Twenty-eight species of reptiles, amphibians, birds and mammals are listed by the U.S. Fish and Wildlife Service.

Coastal dune habitat which supports the sea oat (Uniola paniculata) is protected under Florida Statute 370.41, which prohibits the disturbance or removal of sea oats/habitat. All wetland plant communities are protected under Executive Order 11990-"Protection of Wetlands." Mangroves are protected under Florida

Statute 861.02 primarily because the leaf detritus is an important energy source within the complex marine food chain.

Aquatic habitats include the adjacent waters of the Atlantic Ocean, Indian River, and Banana River; fresh water ponds/canals; brackish water impounds; and salt water tidal lagoons. The CCAFS supports a single, natural freshwater pond (12 acres) and six borrow pits (40 acres) containing fresh water. In addition, approximately 52 miles of fresh water canals are present, providing drainage of low-lying areas. Four major brackish water impounds (100 acres) are located on CCAFS, along the Banana River. The Indian and Banana rivers represent salt water tidal lagoons, although causeway construction and channelization of the intracoastal waterway have resulted in almost negligible flow through the lagoon system.

Fresh water also occurs on KSC, although in unknown amounts and distribution. The surface waters surrounding KSC are best described as shallow estuarine lagoons where oceanic influences are minimal (NASA 1986).

The diverse terrestrial and aquatic habitats present support a variety of mammal (25), bird (285), reptile and amphibian (65), and fish (117) species. (USFWS-MINWR 1986). A number of wildlife management practices are currently conducted to enhance and protect the habitat and fauna of the area. Population control practices are used on two pest mammals, the feral hog (Sus scrofa) and raccoon (Procyon lotor), as well as, Florida white-tailed deer (Odocoileus virginianus).

Herd reduction is used to manage the Florida white-tailed deer, eliminating 300 animals per year from CCAFS habitats. All wild hogs will eventually be removed from CCAFS (approximately 1,000 animals) and over 1,000 wild hogs were removed from Merritt Island National Wildlife Refuge (MINWR) in 1985 (USAF-ESMC 1984; NASA 1986). Raccoon predation of sea turtle nests is deterred by the use of wire fencing over nests.

Approximately 90 bird species are resident breeders in the area, and over 100 species overwinter in the available habitat (NASA 1986). Many wetlands within

MINWR are managed to provide wintering habitat for approximately 200,000 waterfowl. Eleven rookeries for a variety of colonial nesting birds were identified by NASA (1986), and a census of shorebird, gull, tern, and allied species nesting pairs from Banana River spoil islands has also been conducted (See NASA 1986).

Reptiles and amphibian species are year-around inhabitants of the available habitats on-site. Cape Canaveral beaches are one of the major nesting areas for the loggerhead turtle and some green turtles. Mosquito Lagoon is thought to be an important developmental area for juvenile loggerhead, green, and Ridley turtles (NASA 1986).

CCAFS and KSC beaches are not vegetated but support a large number of wildlife species. The tidal zone provides habitat for many marine invertebrates and small fish, constituting a diverse food source for shore birds, including gulls, terns, sandpipers, and many others.

The coastline from Daytona to Melbourne and extending seaward to a depth of 100 fathoms is one of the most productive marine fisheries along the southern Atlantic Coast. Sportfishing is common on inshore waters, particularly for sea trout and red fish. Commercial blue crab and black mullet fishery operations are conducted on the lagoons and rivers. Brevard County leads Florida in the production of quahogs and scallops, a portion of the shell-fishing industry catch. Approximately 30 to 40 million pounds of calico scallops were estimated to have been harvested off the coast of Cape Canaveral in 1984 (NASA 1986). Several renewable oyster leases are held in the offshore waters.

Fresh and brackish waters of the lagoon systems of the Indian and Banana rivers support approximately 150 fish species. This lagoon system provides recreational fish and shrimp fishing, e.g., an es imated 90,300 recreational fishermen used the area in 1985 (NASA 1986).

The fisheries resource of these shallow, inshore water bodies is currently subject to periodic winter and summer die-offs. Temperature drops during winter

months can kill species such as snook, while all fish species may be killed during the summer months due to low levels of dissolved oxygen.

Seagrasses, when present, are important components of the aquatic environment. Important functions of seagrass beds include organic material production; sediment stabilization; and habitat, feeding, and nursery areas for various organisms. The seagrasses are generally found as patches in shoal areas less than one meter deep and are surrounded by open sandy areas. Environmental factors affecting their distribution are the seasonal accumulation and shifting of sediments, water temperature, water depth, salinity, epiphyte coverage, and water clarity.

Benthic macroinvertebrates of the northern Indian and Banana Rivers can be classified as estuarine-marine animals. The benthos is dominated by polychaetes (marine worms), molluscs, and crustaceans. A total of 122 species of benthic macroinvertebrates were collected from brackish lagoons surrounding Launch Complex 39A and the northern Banana River (NASA 1986).

Many species of plants and wildlife are considered threatened or endangered by the Federal and Florida governments. Several species are of special concern, and some habitats, e.g., mangrove and coastal dune, are protected under state statutes.

A combined total of 19 Federal and State laws dealing with various aspects of wildlife conservation and species protection are presently in effect in Florida. Of these the three most significant are the Endangered Species Act of 1973, and the preservation of Native Flora of Florida Act. Seventy species present at CCAFS/KSC are protected or proposed for protection by federal, state and international agencies. Appendix 2 lists the species of plants that are given protection or are under review. Sixty-two species are listed, and all of these are of regulatory concern. The fragrant wool-bearing cereus (Cereus eriophorus var. fragrans) is a Federal endangered plant species. There are no Federally listed threatened species present. Ten species are under consideration for listing at this time.

Twenty-eight species of reptiles and amphibians, birds, and mammals that occur in the area are listed by the U.S. Fish and Wildlife Service (6-threatened, 10-endangered). Of the listed species, the dusky seaside sparrow (Ammospiza maritima ingriscens) is near extinction or extinct and the red-cockaded woodpecker (Picoides borealis) and Florida panther (Felis concolor corii) are very doubtful inhabitants of on-site habitats. Appendix 2 lists the wildlife species that are given protection or are under review.

Of the Federally protected wildlife species, critical habitat is present on-site for the West Indian manatee and dusky seaside sparrow. In addition, the West Indian manatee, bald eagle, wood stork, loggerhead turtle, green turtle, American alligator, eastern indigo snake, and salt marsh snake breed within one or more of the East Coast habitats present (NASA 1986).

3.4.1.3 Hawaii

Numerous sensitive or important biological resources are present in the southern portion of the island of Hawaii and adjacent marine waters. These include state and federally listed threatened or endangered species, candidates for federal listing, rare or special concern species, and ecologically important habitats. The proposed ALS sites and surrounding areas have not been as extensively studied as the West Coast site nor has the information available been as well summarized. Hawaii Volcanoes National Park has data for biological resources within its boundaries. The U.S. Fish and Wildlife Service (1985; 1983a&b), National Marine Fisheries Service, and state Department of Land and Natural Resources also have data on some species and habitats (e.g., threatened or endangered species). A portion of this information was summarized in ADL (1988). Other literature sources include Tomich (1986), Berger (1986), Simons (1983), and Hawaii Audubon Society (1978). Additional literature and field research, however, would be necessary to provide the same level of detail as available for the West and East coasts.

The following provides a brief description of biological resources that could be constraining in siting and operation of the proposed ALS program on Hawaii. Appendix 2 lists these resources, level of constraint, and general location.

- **Federally Listed Threatened or Endangered Species.** About 25 listed species of plants and animals occur on the island or in adjacent marine waters. Several of these species, however, may no longer be present in areas that could be affected by the proposed project (e.g., Hawaiian crow).

- **Candidate, State Listed, and Rare Species.** A number of plant and animal species in this category are present in the proposed project area. Most occur away from the potential facility locations and thus no habitat would be affected.

- **Wetlands.** Few wetlands are present in the Palima Point and Kamilo Point areas. Those in the area include the Hoonoua wetland near Kamilo Point and a marsh near Punalu'u Beach. Small wetlands are also associated with stream (intermittent or perennial) channels.

- **Ecologically Important Habitats.** Coral reefs along the coast are relatively pristine and highly productive. Several species of seabirds nest on the mountains. Native vegetation has been declining as a result of human activities and relatively intact stands are important for preserving the habitat of native species (including those that are state and federally listed). Hawaii Volcanoes National Park and a proposed wilderness area are adjacent to the Palima Point site.

- **Other Resources.** Commercial fishing takes place in coastal waters near the proposed sites.

3.4.2 Environmental Consequences

Construction and operation of the proposed ALS facilities could affect biological resources in the following ways.

- Launch noise -- would extend several miles from the launch site and under the flight trajectory from up to 60 launches per year.

- Rocket exhaust -- solid fuel booster exhaust contains up to three percent HCl by weight. Aluminum oxide particulates are also present, and lithium would be emitted from the solid rocket boosters.

- Land clearing/earth moving -- from construction of facilities and transportation corridors. This includes shoreline modification for new harbor facilities and construction of the nearshore option. A two nautical mile diameter clear area would also be necessary for land recovery of components in the Boeing and United Technologies proposals.

- Waste disposal -- both liquid and solid wastes ranging from domestic sewage to deluge water and lithium batteries would be stored and disposed of.

- Lights -- for security and night operations of facilities.

- Safety zone closure -- would temporarily exclude vessels from an area extending 3 miles from shore along the launch azimuth.

- Accidents -- fires and explosions as well as spills or leaks of toxic materials could occur. Potential locations include launch sites, fuel manufacture or storage sites, waste storage areas, and hazardous materials transport routes.

The following sections discuss biological constraints at the three potential launch sites. Since the five proposed concepts are similar, the constraints would generally be the same at each site. Differences in area disturbed or location of facilities, however, could result in differing constraints, and these are presented below.

3.4.2.1 West Coast

All five concepts proposed using VAFB for land launch, while one concept proposes options for nearshore and offshore launches at VAFB and offshore launches in the Santa Barbara Channel using Port Hueneme for logistical support. For each concept, the noise, rocket exhaust, safety zone closure, and waste disposal from land-based

launches would be about equal. Noise effects on breeding marine mammals along the mainland coast and on the Channel Islands is the most constraining biological factor. Launch restrictions were imposed on the shuttle and similar restriction could be placed on ALS. If this were the case, constraint level would be high, otherwise it would be moderate. Rocket exhaust and waste disposal (other than deluge water) effects on biological resources would result in low to moderate constraint. Disposal of deluge water could have moderate to high biological constraints depending on the mode and location of disposal chosen. Safety zone closure would affect commercial fishing, which could have moderate constraints on the project. The potential for accidents would result in low to moderate biological constraints.

Boeing

Disturbance of about 38 acres for placement of new facilities near SLC-6 plus the area disturbed during construction of 4.7 miles of new roads and 12.4 miles of railroad would likely have moderate constraints. Maintaining a six mile area in the stabilized dunes on San Antonio Terrace for recovery of the core P/A module would affect the many dune swale wetlands, sensitive dune plant community, and associated rare plant species (several of which may be come proposed for federal listing in the near future). The endangered unarmored threespine stickleback resides in San Antonio Creek, and the least tern breeds in the dunes near the mouth of the creek. Thus, biological constraints for this area would be high. Construction and maintenance (dredging) of harbor facilities at the boathouse would affect intertidal and nearshore marine resources as well as the brown pelicans that currently use the breakwater for roosting. Biological constraints on this activity would be moderate to high. Additional lighting in this area would be expected to have minimal effects on important biological resources (low constraint).

Overall biological constraint for the Boeing concept is high.

General Dynamics

Land disturbance for new facilities (35 acres) and transportation corridors would be similar to that for Boeing resulting in a moderate biological constraint. Harbor construction and maintenance would be the same as for Boeing, a moderate to high biological constraint. Lighting would result in low constraint.

Overall biological constraint for the General Dynamics concept is expected to be moderate, but could be high if launch restrictions were required to protect marine mammals from noise effects.

Martin Marietta Corporation/McDonnell Douglas

The land-based portion of this concept would require disturbance of 98 acres at a minimum for construction of new facilities, primarily in the sudden Flats area, but with part near Surf (manufacturing complex). In addition, 20 miles of road, 1 mile of railroad, and harbor facilities at Point Arguello Harbor (as for Boeing) would be built. Lighting would be introduced into as area where little is currently present (low constraint).

Overall biological constraints for the land-based portion of the MMC/MDAC concept would likely be moderate, unless launch restrictions were required to protect marine mammals, in which case constraints would be high.

For the nearshore option, the Point Arguello Harbor and Surf would be upgraded. Launch pads, however, would be placed on two platforms connected to shore about half way to Jalama. Land disturbance effects on terrestrial biological resources would have moderate constraints. Construction effects on intertidal and subtidal resources would have moderate constraints if done when gray whales are not migrating through the area (about June through October or November).

Constraints could be high if offshore construction overlapped the migration period. Lighting effects on terrestrial resources would have low constraints, but effects on marine mammals at the nearby haulout could cause high constraints. Deluge water entering the

ocean would affect intertidal and subtidal organisms, including nearby kelp, gray whales during their migration, and possibly sea otters (potentially high constraint).

Overall constraints for the nearshore option would be high.

The offshore option at VAFB would require a larger harbor facility than for the onshore or nearshore concepts, thereby causing disturbance of more marine habitat. A stationary launch platform would result in seafloor disturbance where the legs would be driven into the bottom, accumulation of launch debris around the platform, and exclusion of commercial fishing for a distance of 0.5 or more miles (depending on security requirements) for the life of the project. Use of mobile platforms (semisubmersible or jack-up) would cause a disturbance of the bottom during construction of concrete foundations. These foundations and anchors will remain in place and be used throughout the ALS program.ere put in place. Unless launch debris (couplings, wire, insulation, hoses, etc.) were removed after each launch, the area would likely become unfishable for trawlers since they could snag their nets on the debris or bottom scars. Deluge water and the contaminants it contains (e.g., heat and particulates) would enter the ocean and adversely affect marine life. Since the deluge water and launch noise could affect migrating gray whales, biological constraints would be high. For the Port Hueneme/Santa Barbara Channel offshore option, migrating gray whales could also be affected as well as nesting brown pelicans on Anacapa Island. Constraints for this option would be high.

Overall biological constraints for the offshore option would be high.

Rockwell

Biological constraints are expected to be about the same as for the boeing concept (moderate unless launch restrictions are required for protection of marine mammals).

United Technologies Corporation

Assuming that the clear area for recovery of the core P/A module would be the same size and at the same location as proposed by Boeing, biological constraints are expected to be high as for the Boeing concept. The area for facilities would be slightly smaller (31 acres compared to 38 acres), but more roads would be built (20 miles versus 4.7 miles). If the core P/A module recovery area were located in an area of lower biological sensitivity, constraints could be reduced to moderate, unless launch restriction were required to protect marine mammals.

3.4.2.2 East Coast

The various ALS concepts currently under consideration range from new facilities located at existing sites to new facilities occupying new locations. Affects to the local biota are primarily related to facilities siting. Due to the large amount of protected habitat and large number of protected species, new development presents a high level of concern. The highest constraints are assessed where new facilities encroach on the existing wildlife habitat.

In general, the biotic affects that would be common to all concepts, including human presence, noise, exhaust cloud, and avifauna/wildlife strikes (erect vehicle and automobile) are not further discussed. Constraints developed for each contractor action are discussed in detail below.

Boeing

Boeing proposes new launch locations at/or near the existing complexes 34 and 37 (Saturn 1B) on CCAFS. Support facilities as described in Section 2.2.2.1 will be constructed on the existing CCAFS Industrial Area. the Boeing proposal also includes a landing footprint upon which the core P/A module would be recovered via parachute. This approximately six-square mile footprint and access would represent new construction south of Mosquito Lagoon at the Shiloh area.

Launch pads, facilities, transportation corridors, and utilities construction/installation will occur on areas previously used for vehicle launching functions. A

portion of the new facilities may consist of an upgrade of existing facilities. Portions of the biotic communities adjacent to facilities expanded for the ALS mission will be removed/altered during development activities.

Since habitats adjacent to the existing facilities are assumed to have received past disturbance during initial development, low constraints for biological resources affects would result at existing sites. High constraints for biological resources will result from footprint installation as protected habitat (wetlands), orchards, open water, and upland habitats are leveled, filled and open water, and upland habitats are leveled, filled and covered over to produce a flat topography. Low-growing grasses or grasses requiring mowing-type maintenance would be introduced primarily for erosion control. Overall high constraints for biological resources will result from development of this ALS concept.

General Dynamics

General Dynamics proposes new launch locations at the existing complexes 34 and 37 (Saturn 1B) on CCAFS. Support facilities as described in Section 2.2.2.2 will be constructed on the existing CCAFS Industrial Area.

Launch pads, facilities, transportation corridors, and utilities construction/installation will occur on areas previously used for missile launching functions. A portion of the new facilities may consist of an upgrade of existing facilities. Biotic communities adjacent to facilities expanded for the ALS mission will be removed/altered during development activities.

Since habitats adjacent to the existing facilities are assumed to have received past disturbance during initial development, low constraints for biological resources affects would result from development of this ALS concept. Should these facilities be expanded to the extent that encroachment occurs on previously undisturbed habitat, it would be necessary to consider the constraints at the moderate or high level, depending on the nature of the adjacent biotic community.

Martin Marietta Corporation/McDonnell Douglas

MMC/MD team proposes new launch locations at the existing Complexes 34 and 37 (CCAFS), a new land launch location north of Complex 39 (KSC), new near-shore launch locations, and new offshore launch locations. Various infrastructure support facilities, as described in Section 2.2.2.3 will also be constructed in the vicinity of new land-based launch pads or in the CCAFS/KSC Industrial Areas.

The land-based launch pads, facilities, transportation access, and utility construction/installation will occur on areas previously used for missile launching (complexes 34 and 37) or on existing wildlife habitat (primarily wetland and aquatic) managed by the USFWS-MINWR (new pad northwest of complex A and B). A portion of the new facilities at complexes 34 and 37 may consist of an upgrade of existing facilities.

Since habitats adjacent to the existing facilities are assumed to have received past disturbance during initial development, low constraints for biological resources affects would result at the existing launch complexes. For development of the new launch site, high constraints for biological resources will result from installation of launch facilities on protected habitat (wetlands), open water, and upland habitats. Installation will require land surface leveling and filling to produce a relatively flat topography.

The near-shore based launch pads, transportation access, and utility construction/installation will occur on areas of existing wildlife habitat (wetland, aquatic, and shoreline) under the management of either USFWS-MINWR or the National Park Service (NPS). Development of these proposed new launch sites will result in high constraints for biological resources affects, because of the occurrence of protected habitats (wetlands, coastal dunes, and mangrove). In addition, it is unknown what effect near-shore launching will have on reproductive efforts of sea turtles, or the biology of other sensitive species.

Sea-based launch pads will be towed three to five miles from the coast for launches. These pads will be stored in the new facilities in the harbor currently used for Trident submarine docking and maintenance. Following attachment to the mobile pad the vehicle

would be towed to the launch site. These waters are important for commercial fishing, shellfishing, and provide habitat for a number of protected species.

High constraints for biological resources will result from sea-based launches due to kills expected from super-heated water and launch related vibrations. All marine biota at a particular launch site would be affected directly or indirectly, including protected habitats such as coral and kelp beds.

Rockwell

Rockwell proposes a new launch location northwest of the existing 39 A and B complexes (Space Shuttle) on KSC. Various infrastructure support facilities, as described in Section 2.2.2.4 will also be constructed in the vicinity of the new launch pad.

Launch pads, facilities, transportation corridors, and utilities construction/installation will occur on areas currently used for wildlife habitat. High constraints for biological resources will result from installation of launch facilities on protected habitat (wetlands), open water, and upland habitats. Installation will require that the land surface be leveled and filled to produce a relatively flat topography.

United Technologies Corporation

UTC proposes new launch facilities on or near complexes 14 and 15 at CCAFS. Support facilities as described in Section 2.2.2.5 will be constructed on the existing CCAFS Industrial Area. The UTC proposal also includes a landing footprint (approximately six-square miles) upon which the core P/A module would be recovered via parachute.

Launch pads, facilities, transportation corridors, and utilities construction/installation will occur on areas previously used for missile launching functions. A portion of the new facilities may consist of an upgrade of existing facilities. Biotic communities adjacent to the facilities expanded for the ALS mission and footprint site will be removed/altered during development activities.

Since habitats adjacent to the existing facilities are assumed to have received past disturbance during initial development, low constraints for biological resources affects would result from launch site development, low constraints for biological resources affects would result from launch site development. High constraints for biological resources will result from footprint installation as protected habitat and sensitive species are likely to occur. Habitat alteration in the form of grass reintroduction on the cleared footprint will also occur. Overall high constraints for biological resources will result from development of this ALS concept.

3.4.2.3 Hawaii

Only two concepts propose launch sites on one island of Hawaii, and one of these has an offshore launch option. No facilities are present on the island, so the minimum area disturbed for facility construction was assumed to be 98 acres (amount needed for construction of all new facilities on VAFB). The amount of new roads was assumed to be at least 20 miles. New harbor facilities will be required for both concepts. For both concepts noise, rocket exhaust, safety zone closures, waste storage and disposal, land clearing, and lighting effects for land-based options would be very similar. Noise could affect endangered forest birds in the Kau Forest Reserve or Hawaii Volcanoes National Park by adding stress that could increase mortality rate or interfere with breeding. This could result in a high biological constraint. Launch vehicle exhaust, waste disposal (except deluge water), safety zone closure, and land clearing effects on biological resources would pose low to moderate constraints. Lighting of facilities would have low to moderate effects on most biological resources and thus have a low constraint. If, however, the lights were to attract fledging Newell's shearwaters and cause them to become disoriented and grounded, a high constraint could result. Disposal of deluge water could have considerable impact on biological resources depending on the mode and location of disposal, and biological constraint could range from moderate to high. The potential for accidents would result in low to moderate biological constraints.

Martin Marietta Corporation/McDonnell Douglas

Disturbance of 98 acres for facility construction at any of the three site options would result in low to moderate biological constraints as would rocket exhaust, waste disposal, safety zone closure, and accidents. Since launch noise and lighting have the potential to cause adverse impacts on several endangered species, this concept is given a high biological constraint.

The construction of extensive harbor facilities near the land-based facility site would impact relatively pristine coral reefs and could affect hawksbill sea turtles if a nesting beach were used. Operation of the offshore mobile launch pads has the potential to adversely affect humpback whales and several other species of marine mammals through launch noise/vibration and discharge of deluge water. Thus, a high biological constraint is given to this option.

Rockwell

Biological constraint for this land-based concept would be high for the same reasons presented under the Martin Marietta Corporation/MCDonnell Douglas land-based concept.

3.5 NOISE

Project-related impacts to the ambient noise levels of an area will occur from both construction-related and operational noise sources. The magnitude of these impacts is dependent on the distance from the noise source to the receptors (populated areas or sensitive animal species), and the difference between the ambient noise levels and the new noise(s). In a relatively noisy area another slight sound will not be noticed. In a quiet rural area a new noise source is immediately noticeable. When a noise recurs over a period of time, people and animals can become accustomed to it, even if it is relatively loud compared to ambient levels (e.g., a freight train every night in an agricultural area). This decrease in the psychoacoustic impacts resulting from repetition of similar noises is a factor in assessing potential ALS impacts at ETR and WTR. At the Hawaiian sites there have been no comparable noises and the psychoacoustic impacts would be significant.

The anticipated noise impacts of the five ALS proposals under consideration are not different enough to make noise a differentiating factor. However, the differences among the three booster options would be significant. The flyback booster option would affect a large area on its return trip to the landing area because of its speed. When the booster separates and starts back to earth its speed would be several times the speed of sound. It would have to pass back through the sound barrier in its descent and, depending on the flight path, could cause significant noise impacts as a result of the sonic boom. Therefore, candidate concepts with a flyback option have higher constraints related to noise impacts than those without such an option.

3.5.1 Affected Environment

3.5.1.1 West Coast

The baseline conditions at VAFB are similar to those at the ETR in that VAFB is an active range for the testing of a variety of launch vehicles. However, the largest of the vehicles launched from VAFB are much smaller than the largest launched from KSC to date. VAFB is a large range and most of the launch sites are located in portions of the range which are relatively remote (5.5 miles from Jalama Beach and 7.1 miles from Lompoc).

3.5.1.2 East Coast

The baseline conditions at the ETR are those associated with launching a variety of sizes of vehicles, using both solid and liquid-fueled engines over the last 20 to 30 years. The Space Shuttle, the largest of the vehicles to be launched from this area, is scheduled to resume launches this year. This will add to the number of launches that take place from the facilities in this area.

3.5.1.3 Hawaii

The area selected on the island of Hawaii is an undeveloped, primarily agricultural region with ambient noise levels which are typical of rural areas. The potential for noise impacts at this location is dramatically higher than for the other sites.

3.5.2 Environmental Consequences

3.5.2.1 West Coast

The analysis of the potential noise impacts of launching the Shuttle and the Titan IV from VAFB showed the 115 db acoustic hazard zone to be set at 38,600 feet. This was not considered a significant impact in those documents. The ALS vehicles would be as noisy as or louder than the two vehicles assessed in the documents mentioned above. The local population's relative lack of experience with launches of this size will cause a higher psychoacoustic impact here than at the east coast sites.

Use of the flyback booster option could cause significant noise impacts as a result of the sonic boom. When the flyback booster passes back through the sound barrier on its descent, sonic booms could affect the Channel Islands and mainland, resulting in high noise constraints.

3.5.2.2 East Coast

The noise impacts related to these launches have been studied and, other than changes in noise apparent to local populations which may occur from slight changes in the location of the actual launch pads and the increase in launch frequency, there would be no major change in noise impacts as a result of the ALS. The local population has experienced several years of large vehicle launches and, as a result, has adjusted to the noise associated with launches

similar in size to the ALS. Consequently, psychoacoustic impact of ALS launches from locations at KSC or CCAFS are expected to be much less than from other proposed locations.

Construction-related noise impacts would be slight because the sites are somewhat isolated. Operational noise impacts resulting from the launches would be higher but probably not significant to the local populace, but should be quantified in future environmental documentation.

As discussed for the west coast, use of the flyback booster option could cause significant noise impacts as a result of the sonic boom. High noise constraints would be associated with potential sonic boom effects on areas adjacent to the ETR.

3.5.2.3 Hawaii

Noise generated by traffic and other construction-related activities would have a noticeable impact on the local population and biota. Operational noise from launches would have large impacts on all local receptors and should be addressed and quantified in future environmental documentation.

As discussed for both the west and east coasts, use of the flyback booster option could cause significant noise impacts as a result of the sonic boom. Areas adjacent to the proposed ALS sites would be affected.

3.6 LAND USE

3.6.1 Affected Environment

3.6.1.1 West Coast

Land use on VAFB is characterized by an urbanized cantonment area on North Vandenberg, scattered launch, test, and tracking facilities on North and South Vandenberg, and open lands which are either in a natural state or used for cattle grazing and agriculture on the remainder of the base.

The Base Development Pattern designates future land use at the base into one of three categories: launch area, technical support area, and base support area. The draft Long-Range Development Program for South Vandenberg assesses the placement of facilities required to support shuttle operations and long-range development of South Vandenberg.

The cantonment (urbanized) area forms the core of VAFB and consists of residential, industrial, community service, administrative, and recreation uses. The launch area of VAFB borders the coast, while the technical support area covers the remainder of the base.

Both North and South Vandenberg have agricultural areas, including land used for grazing and crops. The Sudden Flats area, on the southernmost part of the base, is leased through competitive bid. Currently used for cattle grazing, the existing lease expires in 1990.

San Antonio Terrace, located in northern Vandenberg, is primarily an undeveloped natural area, containing sand dunes, wetlands, and open space. San Antonio Picnic Grounds, an outdoor recreation area, comprises 50 acres with a 1000-person capacity. The grounds provide for passive on-base recreational use, and public access is controlled within specified quotas (USAF 1987).

Within the current base comprehensive plan (BCP) process, fifteen different growth alternatives for VAFB are currently being considered. In mid-August of this year, the Command Staff at VAFB will select approximately 10 of the alternatives for evaluation in the BCP and a future environmental assessment.

Jalama Beach county Park, a 28-acre facility, is located southeast of VAFB. With 0.3 mile of ocean frontage, Jalama Beach provides sites for camping, surfing, windsurfing,

picnicking, and recreational vehicle use. The park is remote, accessible only along a 15-mile, winding road connecting with Highway 1. Although open year-round, Jalama Beach's highest use occurs between May and September (USAF 1987).

Southeast and adjacent to Jalama Beach is Bixby Ranch, a privately owned 26,000-acre working cattle ranch. Except for the ranch itself, Bixby is largely undeveloped. Approximately 100 acres of the Ranch are used for irrigated agricultural production, while the remainder is used for cattle grazing. Planners for Bixby Ranch have proposed to construct new housing developments on the coastal slopes between Jalama Beach and Point Conception (USAF 1983). Precise details of the proposed development have not yet been established.

The northern channel islands are located off shore and southeast of VAFB. Designated in 1980, the Channel Islands National Park includes San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara Islands, and the waters for one nautical mile around each. It is managed by the National Park Service. The Channel Islands National Marine Sanctuary encompasses 1252 square nautical miles of near- and off-shore waters surrounding these islands. These waters were designated as a sanctuary in 1980 for the purpose of preserving the area's recreational, ecological, historical, research, educational, and esthetic values.

Oil lease tracts are located in state and federal waters offshore of VAFB and the surrounding coastal regions. This area includes both existing and proposed oil development sites. Depending on the price of oil and the regulatory framework, oil development could increase in this area in the future.

3.6.1.2 East Coast

The CCAFS and KSC are located in Brevard County on the east coast of Florida, approximately 150 miles south of Jacksonsville, 200 miles north of Miami, and 70 miles east of Orlando. The northern boundary of CCAFS abuts the southern boundary of KSC. The population of Brevard County in 1984 was 323, 055 with major urban areas located in the cities of Titusville (36,701), Cocoa (16,848), Palm Bay (31,276), and Melbourne (51,116). Other communities that are nearby the East Coast facilities include Oak Hill, Scottmoor Mims, Sharpes, Cape Canaveral, Merritt Island,

Rockledge, Cocoa Beach, Patrick AFB, Palm shores, Satellite Beach, and Indian Harbor Beach. Both facilities lie on a barrier island and are described below in detail.

CCAFS is located on approximately 15,400 acres of the Cape Canaveral Barrier Island. The station is bounded by the KSC on the north, the Atlantic Ocean on the east, the City of Cape Canaveral on the south, and the Banana River and Merritt Island National Wildlife Refuge (MINWR) on the west.

CCAFS is Station No. 1 of the Eastern Test Range (ETR), developed in the 1950s. The primary function of the station is to provide launch, tracking, and other facilities in support of DOD, NASA, and other range user programs.

Approximately 30 percent of the station is developed and consists of launch complexes and support facilities. A land use summary follows:

o	Pavement areas	728 acres
o	Improved grounds (grass height not to exceed 4 inches)	175 acres
o	Semi-improved "A" grounds (grass height between 4-15 inches)	1,035 acres
o	Semi-improved "B" grounds (cleared annually or as required)	964 acres
o	Inactive launch complexes	464 acres
o	Facilities	95 acres
o	Wildlife habitat	11,977 acres

CCAFS houses 41 launch complexes, many of which are dismantled or have been deactivated. The base also contains a small industrial area (located at the eastern end of NASA Causeway East), Air Force Space Museum, Cape Canaveral Harbor for the docking of submarines, NASA Mission Control, and a skid strip which was initially constructed for research and development recovery operation for missile launches. Many of the hangars located on base are used for missile assembly and testing. Future land use patterns are expected to remain similar to current on base conditions.

No recreational facilities are present on CCAFS, except for those associated with the Trident Submarine Wharf, e.g., a service club and naval recreation facility consisting of ball fields, tennis, basketball, and volleyball courts. Cultural facilities at the station include the museum, tow facilities, and Mission Control. These are located at the southern portion of the base. Off-Base military and civilian personnel use the recreational and cultural facilities available within local communities.

KSC is comprised of approximately 140,000 acres for which all zoning and land use planning is under NASA directive for implementation of the national space program. Land planning and management responsibilities have been delegated to the National Park Service (NPS) and U.S. Fish and Wildlife Service (USFWS) for areas not directly utilized for NASA operations. Management control over agricultural, recreational, and environmental programs at KSC are administered by these agencies. Moreover, overall zoning and land management objectives of NASA for KSC are to maintain national space mission operations while supporting alternative land uses.

Approximately 5 percent of the center is developed, dedicated to the NASA operations, including facilities, roads, lawn/landscaping, and maintained rights-of-ways. A majority of the area is dominated by the Shuttle Landing Facility, Industrial Area, and VAB Area. Smaller facilities spread throughout the center comprise the remainder of the NASA operational area. A land use summary follows:

- NASA OPERATIONAL CONTROL AREA

- Shuttle Landing Facility	3,128 acres
- Industrial Area	1,336 acres
- VAB Area	694 acres
- Launch Pads	368 acres
- Crawlerway	149 acres
- Miscellaneous NASA Facilities	802 acres

- KSC LAND MANAGEMENT OPERATIONAL CONTROL

- NASA Operational Control	6,507 acres
- National Park Service	6,655 acres
- U.S. Fish and Wildlife Service	126,328 acres

Within the overall plan at KSC, the entire facility has been zoned into three functional units. These zoning units are a Launch Impact Zone, a Launch Support Zone, and a General

Support Zone. The Launch Impact Zone extends from the Shuttle launch pads to the Launch Impact Limit Line and into the Atlantic Ocean. During launch events high sound-pressure levels occur within this zone, thus personnel are excluded. Adjacent to this zone is the Launch Support Zone which contains manned facilities that are essential to launch operations. Facilities typically require special design and support equipment to protect personnel from toxic materials and other potential hazards located within this zone. The general Support Zone extends from the Launch Support Zone to the outer KSC boundary. This Zone contains administrative, logistical, and industrial support facilities which are removed from hazardous operations.

In addition to the NASA operations, the NPS and USFWS manage 132,983 acres outside the NASA controlled facilities/areas. The USFWS manages a majority of these lands including 50,945 acres of the Canaveral National Seashore (CNS) and the 75,383 acre MINWR. NPS administers the remaining 6,655 acres at CNS (57,600 acres comprise the CNS). Only 51 acres of the combined management areas are currently developed.

Land use in the area adjacent to KSC is characterized by a variety of urban and rural uses. KSC is primarily surrounded by Brevard County which has numerous settlements, most of which are adjacent to the Atlantic coast. Residential and commercial development is concentrated along Interstate-95 and US-1, most notably in the Titusville and Melbourne areas. Recreational uses are abundant especially along the coast, including the Canaveral National Seashore and the Sebastian Inlet Recreational Area. Approximately 60 percent of the land area in Brevard County is in farmland which includes cropland, woodlands, and pasture. The majority of this land area is pasture for raising commercial beef; however, citrus crops are an integral part of the agricultural economy. Approximately 2500 acres of citrus trees are planted within KSC in the vicinity of the Indian River. These citrus groves are leased to local farmers.

Management responsibilities of the USFWS include the administration of public interpretation and recreation programs, leasing and regulating citrus grove and apiary permits, conducting ecological management and study programs, and endangered species management programs. All land management programs conducted on MINWR have been developed by the USFWS.

The fire management program used to control vegetation fuel loads and also to maintain increase slash pine forests falls under USFWS administration. Additionally, the USFWS and the Brevard County Mosquito Control District maintain and operate about 75 mosquito control impoundments (21,422 acres).

NPS Management functions of the 6,655 acre area of the CNS include law enforcement, visitor access, stabilization and protection of dune vegetation, sea turtle protection, and exotic species eradication programs. The NPS has developed a Resource Management Plan which summarizes the Services' immediate and long-term resource management objectives.

3.6.1.3 Hawaii

Two of the contractors, Martin Marietta/McDonnell Douglas and Rockwell, have proposed optional launch facilities on the island of Hawaii. While both contractors propose the use of the Palima Point area, Martin Marietta/McDonnell Douglas also propose the potential use of areas near Kahilipali Point and Ka Lae.

Palima Point is classified as Agricultural by the State Land Use Commission, although some of the coastal areas are in the Conservation District. Land in this region is both state and privately owned. The Palima Point area is currently used for macadamia nut farming, grazing, and disposal of sugar cane processing waste. Due to problems of access, the shoreline is not heavily used for recreational activities. A stepping-stone trail provides access to Kamehame Beach, located within a mile of Palima Point to the southwest. Kamehame Beach is used by hikers, researchers, and recreational and commercial fishermen (ADL 1988).

The closest population settlements to Palima Point are Pahala, located approximately 2 to 3 miles to the northwest, and the Punalu'u Resort, located approximately 3 miles to the southwest. The Punalu'u Resort has an estimated daily population of up to 400, with plans for future development (ADL 1988). Punalu'u Beach Park is a recreational area used primarily for picnicking and fishing. The southern boundary of Hawaii Volcanoes National Park is located approximately 1.5 miles of the Palima Point area.

Hawaii Volcanoes National Park encompasses an area of over 200,000 acres, about 90 percent of which is managed with an emphasis on the conservation of natural resources (Hawaii

Volcanoes Statement for Management 1985). Visitor use is year-round and totaled approximately 2,600,000 in 1984 (Hawaii Volcanoes Statement for Management 1985). Tourists come to the park to view volcanic eruptions, picnic, sightsee, hike, camp, and fish. The majority are day-use visitors, although a small number of campgrounds provide some night-time use. The management and land use goals of the park include the conservation of volcanic features and preservation of inherent scenic values (Hawaii Volcanoes Statement for Management 1985). Future trends of adjacent land use are of particular concern to the management directors of the park. Factors associated with future developments, including air pollution, noise, vista degradation, and increased access to remote areas, are noted as having the potential to adversely affect park resources (Hawaii Volcanoes Statement for Management 1985).

The Kahilipali Point area is classified as Agricultural by the State Land Use Commission, except for the coastal areas which are in the Conservation District. This area is both state and privately owned, with over 100 individual owners of parcels ranging in size from 12,000 square feet to several hundred acres (ADL 1988). The land is currently used for macadamia nut farming, grazing, and some residential development.

The principle population settlement near Kahilipali Point is Na'alehu, located approximately 4 miles to the north with a population of about 1300 (ADL 1988). Discovery Harbor, a residential development, is about the same distance away and located west of Na'alehu. Several residences are also located in the Ka'alu'alu Bay area, approximately 3 miles southwest of Kahilipali Point. Ka'alu'alu Bay is used as a recreational area by local residents (ADL 1988). Kahilipali Point is within 15 miles of the southern boundary of Hawaii Volcanoes National Park.

South Point, or the Ka Lae area, is classified as Agricultural by the State Land Use Commission, with coastal regions included in the Conservation District. Land ownership is both state and private. Current land use includes grazing, recreation, and residential development. Hikers, picnickers, and commercial and recreational fishermen frequent South Point. This area provides access to the National Historic Landmark at South Point. South Point Air Force Station is located approximately 2 miles north of Ka Lae. Hawaii Volcanoes National Park lies approximately 24 miles southwest of South Point.

3.6.2 Environmental Consequences

Land use issues associated with the ALS proposals include:

- o displacement or conversion of land use which is incompatible with existing management objectives, or
- o adverse affects to surrounding land use through project-related noise, air pollution, vista degradation, traffic, or disruption of existing or planned land use activities.

3.6.2.1 West Coast

Current operations at VAFB are somewhat restricted by adjacent off-shore land use (development) within the potential impact area during initial launch phases. Off-base areas within the flight corridors are Jalama Beach, Bixby Ranch, lands adjacent to Point Conception, the western portions of Hollister Ranch and the western islands of the Channel Islands National Park. All ALS concepts would adversely affect these areas.

Boeing

Boeing's proposal to use existing Vandenberg facilities and modify SLC-6 is consistent with the existing uses of the base and direct construction effects would be associated with a low land use constraint. Temporary increases in traffic and noise would occur during the construction period. Noise and visual resources are addressed in sections 3.5 and 3.7, respectively.

A moderate land use constraint would be associated with development of a P/A module landing site on the San Antonio Terrace. While Boeing does not specify a location for the landing area, due to the amount of area required (six square miles) undisturbed natural regions, including wetland and dune areas, are likely to be affected. Although conversion of open and natural areas would not necessarily be inconsistent with the management objectives of the base, loss of these sites may be highly sensitive with regard to visual, biological, and other resources considered elsewhere in this document.

VAFB's ability to support near-polar launches is a function of its geographical location. The Central California coast turns sharply eastward approximately 10 miles south of VAFB at Point Conception. This allows for space launch vehicles

to be launched from VAFB along southerly launch azimuths without overflying areas of population concentrations. This is critical to space launch activities as Air Force safety procedures require that acceptable safety levels be maintained for all launch activities. VAFB is unique for this very reason. It is the only location in the continental United States where southerly space launches into near-polar orbits can be achieved without overflying areas of population concentrations.

This is not to say that space launches from VAFB do not overfly land areas controlled by non-Air Force entities. The area between the southern boundary of VAFB and Point Conception is subject to overflight by the most southerly launch azimuths from VAFB. However, this area is undeveloped for the most part, consisting primarily of a large cattle grazing operation and associated ranch operations, and Jalama Beach County Park. Oil and gas development in the waters south of VAFB are also subject to overflight from space launches from VAFB. Though there are people in the area during space launch operations, the safety risk to people from these launch operations is low when analyzed on an individual basis and is within an acceptable level as defined by Air Force safety guidelines and procedures. Safety during space launch operations becomes an issue when the number of individuals and the populations density or concentration reaches a level where the risk to the group increases to an unacceptable level as defined by Air Force safety guidelines and procedures.

To manage this increased risk due to population density, the Air Force has negotiated agreements with Jalama Beach County Park to close the park when Air Force safety models indicate that people at the park would be exposed to an unacceptable risk from a launch from VAFB. In addition, the Air Force encourages the operators of off-shore oil and gas platforms and exploration vessels to remove all non-essential personnel if launch safety models indicate that they are within a space vehicle overflight zone. The risk from any given space launch is a function of the vehicle, its launch location and its launch azimuth.

Given the few individuals associated with the cattle grazing and ranch operations, and the low population density in this area, the current ranching operation does not represent a safety issue to current or future space launch operations from VAFB. The Air Force continually monitors proposed development in the areas adjacent to VAFB and will evaluate

the safety risk factor for any proposed development and its potential operational impact on space launch activities from VAFB.

The potential number of launches of ALS from VAFB under the expanded mission model (18 to 20 per year) and the Boeing proposal to utilize SLC-6 could result in an substantial increase in the number of times per year that Jalama Beach County Park would be closed due to an unacceptable risk from launch operations at VAFB. The number of ALS launches could also impact the operation of off-shore oil and gas platforms and exploration vessels as non-essential personnel would be encouraged to be removed on a more frequent basis than is currently experienced. However, the increased number of launches associated with ALS should not result in unacceptable risk to the current cattle grazing and ranch operations south of VAFB.

Given the existing use of land and the ocean south of VAFB, the Boeing proposal for ALS has been assigned a moderate level of constraint on land use due to risks from increased space launch activities associated with ALS. This constraint could be increased to the high level if additional development resulted in population densities and concentrations that restricted certain launch azimuths due to an unacceptable level of risk to the public.

General Dynamics

General Dynamic's proposal to develop new launch facilities in the Sudden Flats region of southern Vandenberg is consistent with the management objectives of the base and the construction of facilities would be associated with a low land use constraint. Although the Sudden Flats area is currently used for grazing cattle, development of a launch facility in this area is consistent with the Long-Range Development Program for South Vandenberg. Temporary increases in traffic and noise would occur during the construction period. Noise and visual resources are addressed in sections 3.5 and 3.7, respectively.

Off-site land use constraints are similar to those discussed under the Boeing concept. Due to off-base land issues associated with operations, the General Dynamics proposal has been assigned an overall level of moderate constraint.

Martin Marietta Corporation/McDonnell Douglas

Low land use constraints would be associated with the construction of facilities at Sudden Flats as described for General Dynamics. For the proposed offshore option at Vandenberg, development of a larger harbor facility would pose low land use constraints. Although a substantial amount of dredging and harbor modification could occur, the land use would not be incompatible with current use of the area. Visual resources are discussed in section 3.7.

Martin Marietta Corporation/McDonnell Douglas also propose offshore launch facilities based at Port Hueneme, near Oxnard, California. These facilities would be located in the current port area and would require expansion of the harbor for jack-up and semisubmersible access options. The land use would not be incompatible with current use of the existing facilities and would be associated with a low level of constraint.

Off-site land use constraints are similar to those discussed under the Boeing concept. Due to off-base land issues associated with operations, the MMC/MD proposal has been assigned an overall level of moderate constraint.

Rockwell

Low land use constraints would be associated with the use of existing facilities and modification of SLC-6 as described for Boeing.

ALS operations from proposed Rockwell facilities at Vandenberg would be associated with moderate off-base land use constraints as described for Boeing.

Due to off-base land use issues associated with operations, the Rockwell proposal has been assigned an overall level of moderate constraint.

United Technologies Corporation

Low land use constraints would be associated with the construction of facilities at Sudden Flats as described for General Dynamics.

United Technologies Corporation also proposes a P/A module landing site on Vandenberg, although no location is specified. Assuming that the land requirements would be similar to Boeing's (six square miles), the land use

constraint could range from low to high, depending on location. If the San Antonio Terrace region were to be used, constraints would be as described for Boeing. ALS operations from proposed UTC facilities at Vandenberg would be associated with off-base land use constraints as described for Boeing.

Due to off-base land use issues associated with operations, the UTC proposal has been assigned an overall level of moderate constraint.

3.6.2.2 East Coast

The five ALS concepts include a variety of needs ranging from the upgrade and use of existing facilities to the development of new facilities. Land use consequences which result in constraint determination for the East Coast are included in the ensuing section. One off-site land use impact that cannot be included at this time, but may be of importance in future considerations is the ability to produce and deliver adequate amounts of aggregate from local sources.

Boeing

Boeing proposes new launch locations at the existing complexes 34 and 37 (Saturn 1B) on CCAFS. In addition, the facilities described in Section 2.2.1.3 will be constructed on the existing CCAFS Industrial Areas. The Boeing proposal also includes a landing footprint upon which the core P/A module would be recovered via parachute.

Launch pads, facilities, rail and roadway transportation, and utility construction/installation will occur on areas previously used for missile launching functions. A portion of the new facilities may be upgrades of existing facilities. Therefore, the overall land use relative to the Boeing proposal for these elements is not changed and impacts resulting from development would be considered low. However, the approximately six square mile diameter landing footprint and access would represent new construction south of Mosquito Lagoon at the site of Shiloh. Currently this area contains a small amount of urban development, but is primarily under cultivation for orchards in the southern one-third, while wetland, open water, and upland wildlife habitats comprise the remainder of the site. Development of a landing footprint will require leveling the entire area and introducing low-growing grasses for surface vegetation cover and erosion control. The impact for this element of

the Boeing proposal is considered high. High constraints for land use would result from development of this ALS concept.

General Dynamics

General Dynamics proposes new launch locations at the existing complexes 34 and 37 (Saturn 1B) on CCAFS. In addition, the facilities described in Section 2.2.1.3 will be constructed on the existing CCAFS Industrial area.

Launch pads, facilities, rail and roadway transportation, and utility construction/installation will occur on areas previously used for missile launching functions. A portion of the new facilities may be upgrades of existing facilities. Therefore, the overall land use relative to the General Dynamics proposal is not changed and impacts resulting from development would be considered low. Low constraints for land use would result from development of this ALS concept.

Martin Marietta Corporation/McDonnell Douglas

The Martin Marietta Corporation/McDonnell Douglas team proposes new launch locations at the existing complexes 34 and 37, a new land launch location north of complex 39 (in the vicinity of the 39 A and B complexes), new near-shore launch locations, and new offshore launch locations. Various infrastructure support facilities, as described in Section 2.2.1.3 will also be constructed in the vicinity of new land-based launch pads or in the CCAFS/KSC Industrial Areas.

The land based launch pads, facilities, transportation access, and utility construction/installation will occur on areas previously used for missile launching (complexes 34 and 37), or currently used as wildlife habitat (wetland and aquatic habitats, primarily) and managed by the USFWS-MINWR (Complex 39). Therefore land use at complexes 34 and 37 is not changed and impacts resulting from development would be considered low, however, development near complex 39 would result in change from the existing land use and impacts at this site would be considered high. As a result, high constraints for land use would result from development of this land based ALS concept.

The near-shore based launch pads, transportation access, and utility construction/installation will occur on areas currently used for wildlife habitat and recreation.

Existing wildlife habitat (wetland, aquatic, and shoreline) and recreational/natural areas (Canaveral National Seashore) are managed by either USFWS-MINWR or NPS. Therefore, selection of near-shore launch sites would result in land use change and impacts resulting from development would be considered high. High constraints for land use would result from development of this near-shore based ALS concept. Sea-based launch pads would be towed to sea, to the launch area 3-5 miles from the coast. These pads would be stored in the harbor currently used for Trident submarine docking and maintenance prior to attaching the missile and tow-out for launch proceedings. These pads and the closure zones associated with safety issues would lie on waters currently supporting commercial fishing/shellfishing and recreation activities. Therefore, selection of sea-based launch sites would result in use change through restrictions, and the impacts generated would be considered high. High constraints for land use would result from development of this sea-based ALS concept.

Rockwell

Rockwell proposes a new launch location, in the vicinity of the existing 39 A and B complexes (Space Shuttle) on KSC. Various infrastructure support facilities, as described in Section 2.2.1.3 will also be constructed in the vicinity of the new launch pad.

The launch pad, facilities, transportation access, and utility construction/installation will occur on areas currently used as wildlife habitat (wetland and aquatic habitats, primarily), and managed by the USFWS-MINWR. Therefore, the existing land use would be changed under the Rockwell proposal and impacts resulting from development would be considered high. High constraints for land use would result from development of this ALS concept.

United Technologies Corporation

UTC proposes new primary and secondary launch locations near the historic complexes 14 and 15 on CCAFS. In addition the facilities described in Section 2.2.1.3 will be constructed on the existing CCAFS Industrial Area. The UTC proposal also includes a landing footprint upon which the coil P/A module would be recovered via parachute.

Launch pads, facilities, rail and roadway transportation, and utility construction/installation will occur on areas previously used for missile launching functions. A portion

of the new facilities may be upgrades of existing facilities. Therefore, the overall land use relative to the UTC proposal for these elements is not changed and impacts resulting from development would be considered low. However, the approximately six-square mile landing footprint and access would represent new construction. Development of landing footprint will require covering over or altering the entire area to produce a level pad. Low-growing grasses for surface vegetation cover and erosion control would be introduced. The impact for this element of the UTC proposal is considered high. High constraints for land use would result from development of this ALS concept.

3.6.2.3 Hawaii

Martin Marietta Corporation/McDonnell Douglas

High land use constraints would be associated with the MMC/MD option proposing the island of Hawaii as a launch site. The proposed launch site locations are currently zoned as either agricultural or conservation areas. Development of the ALS project at the Palima Point, Kahilipali Point, or South Point locations would be inconsistent with current planning and zoning and would be incompatible with the surrounding area.

Use of the Palima Point area would displace current macadamia nut farming and grazing activities. Disposal of sugar cane processing waste, also a current use, could potentially continue. Recreational activities at Kamehame Beach would be disrupted or eliminated. Air pollution, noise, vista degradation, and increased human activity resulting from the project would adversely affect the adjacent use of Hawaii Volcanoes National Park. Because the park boundaries are within 1.5 miles of the Palima Point area, security measures associated with ALS have the potential to disrupt park activities. A launch facility at this location would be incompatible with the management goals of Hawaii Volcanoes National Park.

Although farther from the Hawaii Volcanoes National Park (approximately 15 miles), use of the Kahilipali Point area for ALS would have the potential for adversely affecting the park as described for the Palima Point location. The land between the park boundary and Kahilipali Point can be described as moderately sloping and sparsely vegetated, providing sweeping views over large distances. A launch facility at this location would most likely be visible from the park and constitute vista degradation. Air pollution,

noise, and increased human activity could adversely affect park activities, although to a lesser extent than a facility located at Palima Point. Current use of the Kahilipali Point area for macadamia nut farming and grazing would be displaced. Residential developments located near this area would be adversely affected by air pollution, noise, vista degradation, and potential security measures associated with ALS. Recreational use of the Ka'alu'alu Bay area would be disrupted or eliminated.

Use of the Ka Lae area could adversely affect activity at Hawaii Volcanoes National Park as described for the other two locations. Due to its distance from the park boundary (approximately 24 miles), however, potential impacts would probably not be as severe. Current use of the area for grazing would be displaced. As described for the Kahilipali Point area, existing residential developments in Kae La would be adversely affected by ALS development. Current recreational activities at South Point would be disrupted or eliminated due to facility development or security measures associated with the project. Access to the National Historic Landmark could potentially be eliminated, at least on a temporary basis.

Rockwell

High land use constraints would be associated with the Rockwell Hawaii option as described for the McDonnell Douglas/Martin Marietta proposal at Palima Point.

3.7 VISUAL RESOURCES

3.7. Affected Environment

3.7.1.1 West Coast

Visual resources at VAFB include a diversity of landform, vegetation, and water features within the coastal zone and the inland areas. The coastal area is characterized by varying topography consisting of broad plains located in the southernmost region of the Base (e.g., Sudden Flats), steep bluffs and canyons, rocky shorelines and promontories (e.g., Point Pedernales and Point Arguello); dunes, and beaches. The vegetation in these areas, such as grasslands and coastal shrubs, is typical of coastal plant communities (USAF, 1987).

The coastline and coastal zone are characterized by such visual features as bluffs, shorelines, river outlets, and sand dunes. The dune system extends approximately five miles from Point Sal Road to south of San Antonio Creek. This area is characterized by wind-blown and generally stabilized sand dunes of varying height and depth with sensitive floral and fauna habitats. The active dune area is located within the coastal area. The more stabilized dunes extend inland for approximately three miles to El Rancho Road. The coastal zone provides areas for passive on-base recreational use at Minuteman Beach, Ocean Beach Park, and Civilian Beach, and off base at Point Sal State Beach.

The inland area of the south base is dominated by the Santa Ynez Mountain range and Tranquillon Mountain. The topographic features vary from gently rolling hillsides in the Lompoc Terrace area to steep, sloping terrain with numerous canyons and valleys, which are typical of the southernmost portion of the base. Many of the valleys and canyons in this area contain natural springs, intermittent creeks, and perennial streams. Vegetation communities in these areas include grasslands, coastal scrub, chaparral, and woodlands. Much of the open land within the south base is leased for cattle grazing.

Within the coastal area of the south base are facilities and support systems for the Space Shuttle System. The area includes the space launch complex facilities, support facilities (e.g., remote radar and telemetry), and other

buildings. Jalama County Beach, adjacent to the southern boundary of the base, is a frequently used recreation and camping area.

Important man-made features of historical interest are located throughout VAFB. Buildings or areas associated with historical features and considered visually sensitive resources include the Point Arguello Coast Guard rescue station, Marshallia Ranch housing, and the Destroyer monument.

3.7.1.2 East Coast

KSC is located on 139,490 acres on the north end of Merritt Island, a barrier island bordered on the west by the Indian River (actually a brackish-water lagoon), on the south and east by the Banana River (also a brackish-water lagoon) and on the north by the Mosquito Lagoon. Island topography is characterized by undulating beach ridges on the eastern side, with troughs at about sea level and the ridges rising to an elevation of about 10 feet (E.E. Clark, 1986). The western side of the island is nearly level, with an elevation of about 4 feet above sea level. Large areas of the island can be characterized as wetlands, with numerous lakes, ponds, sloughs, and man-made canals scattered throughout the area. Vegetation communities include beach, swamp and coastal salt marsh, coastal strand and dunes, coastal scrub, pine flatwood, and coastal hammock (ESE, 1988). KSC is dominated by undeveloped lands. Undisturbed areas, including uplands, wetlands, mosquito control impoundments, and open water areas comprise approximately 95 percent of the KSC area. Nearly 40 percent of KSC consists of open water areas, including portions of the Indian River, Banana River, Mosquito Lagoon, and all of Banana Creek (E.E. Clark, 1986). The developed areas of KSC contain launch pads and support facilities, an industrial area, roads and crawlerways, and the space shuttle landing strip.

CCAFS is located to the south and east of KSC on the Cape Canaveral barrier island and contains 15,438 acres. This island is approximately 4.5 miles wide at the widest point and separates the Atlantic Ocean from the Indian River, Indian River Lagoon, and Banana River. The island is composed of relict beach ridges formed by wind and waves and ranges from sea level to 20 feet of elevation at it highest point. Vegetation communities at CCAFS include beach, coastal strand and dune, coastal scrub, brackish marsh, coastal hammock, and mangrove swamp.

Approximately 30 percent of CCAFS is developed, and consists of launch complexes and support facilities. The remaining 70 percent is undeveloped (ESE, 1988). Parts of both KSC and CCAFS are within the boundaries of the Canaveral National Seashore and the Merritt Island National Wildlife Refuge. In addition, Playalinda Beach, a frequently used public beach, is located within KSC boundaries.

Man-made features of historical interest include launch complexes used at CCAFS during the manned space program. Seven launch complexes and the mission control center are part of the "Man in Space" National Historic Landmark Program (ESE, 1986). Launch complexes 39A and B at KSC are listed in the National Register of Historic Places, and are currently used as space shuttle launch sites.

3.7.1.3 Hawaii

Palima Point is located on the southeastern coast of the island of Hawaii, approximately 3.5 miles southeast of the community of Pahala, and 4 miles southwest of the current boundary of Hawaii Volcanoes National Park. The site is located on the lower portion of the southwest rift zone of Kilauea volcano. Topography in the general area is mostly level to slightly sloping to the coast. Sea cliffs in this area have average heights of 20 to 40 feet from Waiaola Spring to Palima Point and 40 to 60 feet northeast of Palima Point (A.D. Little, 1988). The ground surface consists of unweathered lava flows and vegetation in the area is sparse to bare. Current land uses in the surrounding area include macadamia nut growing, grazing, and disposal of sugar cane processing waste. The area is only accessible by rough four-wheel drive trails, and use of the shoreline near Palima Point is limited. Kamehame Beach, a cobble beach in the area which is accessible by foot trail, is occasionally used by fishermen, hikers, and opihi pickers. The most frequently used beach area is the black sand beach at Punaluu Beach Park, approximately 5 miles southeast of Palima Point.

Kahilipali Point, also located on the southeastern coast of Hawaii, is approximately 4 miles south of the community of Naalehu, and is located on the southeastern flank of the Mauna Loa volcano. The topography at this site is level to slightly sloping toward the coast, with sea cliffs averaging 20 feet high (A.D. Little, 1988). The ground surface of the site is mostly weathered lava, and the area is primarily used for grazing. The site is only accessible from rough

four-wheel drive roads, and, as a result, beaches in the area are infrequently used. Nearby Kaalualu Bay is used for recreation, primarily by local residents.

Ka'Lae, also known as South Point, is located at the southern tip of Hawaii. The area is characterized by nearly level to moderate slopes, and relatively young lava flows (Hawaii County, 1987). Ka'Lae can be accessed by South Point Road and is the location of a Coast Guard Reserve Station. Hawaii County, as part of its general plan, describes Ka'Lae as a unique scenic landscape, and is proposing to develop a 28.8 acre site at Ka'Lae as a park, with facilities for camping, fishing, picnicking, hiking, and nature study. Ka'Lae is already a popular fishing area.

3.7.2 Environmental Consequences

Potential environmental consequences to visual resources include:

- o construction of buildings;
- o launch complexes;
- o construction of roads, crawlerways, powerlines and other infrastructure items.

3.7.2.1 West Coast

Boeing

Boeing does not propose to use VAFB as part of the normal mission concept, however, they plan to modify the existing SLC-6 launch facilities for the expanded mission. Modifications would include the addition of an ALS processing facility in Sudden Flats east of the Point Arguello Harbor with new crawlerways that would extend to the launch site. Boeing also proposes to use the proposed SLC-7 launch pad, if built, as a back up. Locating the ALS processing area at Sudden Flats would create a moderate visual constraint, since the facilities would be visible from Jalama Beach County Park, a heavily used recreation area, which is approximately 6 miles away. Currently there is no development in the Sudden Flats area, therefore the presence of large buildings would be noticeable, even from the proposed distance. The facility would be viewed across open water, with no intervening terrain between the

facilities and the beach. Development in Sudden Flats would also be highly visible to passengers on Amtrak trains which use the Southern Pacific route.

Boeing also proposes a P/A module landing area in the dunes near San Antonio Terrace in the northern part of VAFB. The landing area would require leveling and clearing the dunes in a six square mile diameter area. A specific location for the landing area is not given, however due to the amount of area required, sensitive dune areas near the coastline are likely to be affected. Because of the undisturbed nature of the dunes, the uniqueness of the area, and its current use as a passive recreation area, the location of a P/A module landing area at San Antonio Terrace would be considered a high visual constraint.

General Dynamics

General Dynamics proposes to use VAFB for both the normal and expanded mission concept with construction of all new facilities in the Sudden Flats area. Launch pads would be located east of the Point Arguello Harbor and west of Round Hill, approximately 6 miles from Jalama Beach, with the integration facilities located southeast of the launch pads, approximately 2 miles from Jalama Beach. Locating integration facilities in the southern part of Sudden Flats would constitute a high visual constraint, since they would be highly visible from Jalama Beach and would be out of character with the surrounding landscape. Location of the launch pads between the boathouse and Round Hill would constitute a moderate visual resource constraint (see discussion for Martin Marietta corporation/McDonnell Douglas, below).

General Dynamics also proposes widening and paving an existing dirt road from Lompoc to the processing facilities. This is likely to create moderate visual constraints with regard to residents in the area of the road. The proposal also includes a provision to reroute the Southern Pacific Railroad line to the east, away from the coast and off base property. This action would eliminate coastal views along this route by Amtrak passengers. Since this route only provides coastal views between San Luis Obispo and Santa Barbara, the elimination of this part of the route could be considered a moderate constraint. Construction of a new Southern Pacific route is also likely to result in moderate to high visual constraints, depending on the location of the route.

Martin Marietta Corporation/McDonnell Douglas

MMC/MD proposes land, near-shore and offshore launch for VAFB for both the normal and expanded missions. In all three cases, launch support facilities would be located in Sudden Flats. For land and near-shore launch, the facilities would be located near Point Arguello harbor at a distance of 6.5 miles from Jalama Beach. Launch facilities for the land option are proposed east Point Arguello harbor near Round Hill, at a distance of approximately 5.5 miles from Jalama Beach. Near-shore option launch pads would be located offshore and slightly south of Round Hill, at a distance of 5 miles from Jalama Beach. Offshore launch support facilities would be located on the coast near Round Hill. Placement of facilities at these locations in Sudden Flats would create moderate visual constraints, due to their visibility from Jalama Beach (see discussion for Boeing, above). The location of launch facilities in addition to vehicle processing facilities at Sudden Flats is somewhat more constraining than location of just vehicle processing facilities since launch facilities are tall and are likely to be highly visible from great distances, especially when no intervening terrain is available to screen them from view.

Offshore launch platforms would be towed out to a distance of 3 to 5 miles from shore. Assuming that 20 launches per year could take place under the expanded mission concept, and that offshore check-out and launch would take approximately 2 weeks, it is likely that two or more mobile launch pads may be visible off the coast at any one time during most of the year. At the proposed distance, these pads are likely to be seen from several sensitive viewing areas, depending on where the pads are located. Areas that could possibly be affected include Jalama Beach County Park, Ocean Beach County Park, and Point Sal State Park. Offshore launch facilities are likely to create moderate visual resource constraints.

Martin Marietta Corporation/McDonnell Douglas also proposes off-shore launch facilities based at Port Hueneme, near Oxnard California. These facilities would be located in the current port area and would require expansion of the port area. This expansion would create low visual constraints. Offshore launch 3 to 5 miles from Port Hueneme, using the same assumption as for VAFB, are likely to cause moderate to high visual resource constraints, depending on the proximity of the launch site to Channel Islands National Park.

Rockwell

Rockwell proposes modifying existing SLC-6 launch facilities for both the normal and expanded mission concepts. Modification would involve adding new buildings in the SLC-6 area, which would create low visual resource constraints.

Rockwell also proposes new launch facilities in the Sudden Flats area as part of the expanded mission concept and as part of the normal mission if SLC-6 is unavailable. These facilities would be located in approximately the same location as the Martin Marietta Corporation/McDonnell Douglas land launch facilities, and would have similar visual constraints.

United Technologies Corporation

UTC proposes facilities at VAFB for both mission concepts, and also proposes launch pads and support facilities in Sudden Flats, in approximately the same areas as those proposed for Martin Marietta Corporation/McDonnell Douglas and Rockwell. UTC's proposed facilities in Sudden Flats would have visual resource constraints similar to those for Martin Marietta Corporation/McDonnell Douglas and Rockwell.

UTC also proposes a P/A module landing area similar to the one proposed by Boeing. No location is given, however due the area required for such a facility, moderate to high to visual constraints may be expected, depending on the location chosen.

3.7.2.2 East Coast

Boeing

Boeing proposes new launch pads at existing launch complexes 34 and 37, with launch support facilities located in the industrial area at CCAFS. Location in these areas would constitute a low visual constraint, since the facilities would be similar in visual character to surrounding land uses.

Boeing also proposes a P/A module landing area in the northern portion of KSC, in the "Shiloh" area. The construction of the P/A module landing area would require clearing and leveling a six-square mile diameter area. The proposed area at KSC is located within the boundaries of the Merritt Island National Wildlife Refuge and the Canaveral National Seashore. The site is mostly undeveloped, except

for portions of the site that contain citrus groves. The cleared area would be clearly visible from Kennedy Parkway North, which passes through the Shiloh area to the southern portions of KSC. The public has access to this road, and it is used by commuters and visitors to KSC and CCAFS. High visual constraints would result from the construction of the P/A module landing area in this location.

General Dynamics

Like Boeing, General Dynamics proposes use of launch complexes 34 and 37 and the areas adjacent to the current industrial area at CCAFS for its proposed facilities. Location of launch facilities in these areas would result in low visual resource constraints.

Martin Marietta Corporation/McDonnell Douglas

For land launch, MMC/MD proposes new launch pads approximately 1 to 2 miles north of LC 39B. Near-shore option launch pads would be located offshore from the proposed land launch pads. For both options, launch support facilities would be located next to Banana Creek, east of the railroad and the shuttle landing strip. All of the facilities are located in undeveloped regions within the Canaveral National Seashore and the Merritt Island National Wildlife Refuge. In addition, construction of new launch pads either at the LC 39 or at the near-shore locations would result in closing Playalinda Beach, a heavily used recreation area, to the public. As a result, use of this area within a KSC would result in high visual resource constraints. In addition, launch complexes 39A and B have been placed on the National Register of Historic Places, however, since other launch facilities are close to these pads (including LC 41, which is approximately 1 mile south of 39A), location of ALS pads in this area would result in a moderate constraint with regard to these historic features.

For the offshore option, MMC/MD proposes launch support facilities in the turning basin area of CCAFS. Such facilities would be consistent with the current industrial land uses in that portion of CCAFS and would create low visual constraints. As part of the offshore option, mobile launch pads would be towed out 3 to 5 miles for launch. Assuming a launch rate of 20 per year, and that check-out and launch would take up to 2 weeks for each launch pad, it can be assumed that two or more mobile launch pads may be

visible from shore at any given time. Depending on the location chosen for the launches, moderate to high visual constraints could occur.

Rockwell

Rockwell proposes launch pads and support facilities in approximately the same locations as the Martin Marietta Corporation/McDonnell Douglas KSC land launch option. As for Martin Marietta Corporation/McDonnell Douglas, high visual resource constraints would occur at these locations.

United Technologies Corporation

United Technologies Corporation proposes the placement of new launch pads near launch complexes 14 and 15 at CCAFS, with launch support facilities near the existing skid strip, adjacent to the lighthouse. Launch complex 14 is one of the launch sites that is being maintained by the National Park Service and the Air Force through the "Man in Space" National Historic Landmark Program. Launch complex 14 was used in the famous 1962 launch of John Glenn during the Mercury program. In addition, the launch complex 14 and the Cape Canaveral lighthouse have been identified as eligible for listing in the National Register of Historic Places. As a result, modification of the facilities around launch complex 14 and the lighthouse is likely to create high visual constraints.

United Technologies Corporation also proposes a P/A module landing area similar to the one proposed by Boeing. No location is given, however due the area required for such a facility, moderate to high visual constraints may be expected, depending on the location chosen.

3.7.2.3 Hawaii

Martin Marietta Corporation/McDonnell Douglas

Martin Marietta Corporation/McDonnell Douglas proposes new facilities for the land based option at three locations on the island of Hawaii: Palima Point, Kahilipali Point, and Ka'Lae. They also propose the offshore launch option at Palima Point only.

Launch facilities at Palima Point would be within 4 miles of the current boundary of Hawaii Volcanoes National Park, and within 1 mile of an area which the park plans to annex in the future. The facilities potentially would be visible from many locations within the park, including the Kilauea volcano and Mauna Loa. In addition, the areas of the park closest to Palima Point are currently designated wilderness areas, and the annex area would receive a similar designation, should it become part of the park. Due to the proximity of the park, and the current undisturbed nature of the area, construction of launch facilities at Palima Point would constitute a high visual constraint. Mobile launch platforms, required for the offshore option, located 3 to 5 miles offshore, would create moderate to high constraints, depending on their location.

Kahilipali Point is located farther from Volcanoes National Park than Palima Point and therefore, location of launch facilities at this location would be less visually constraining, although launch facilities may still be visible from higher elevations on the island, including Route 11 and the community of Naalehu. Like Palima Point, the area is undeveloped and remote. Development of launch facilities in this area is likely to create moderate visual resource constraints.

Ka'Lae, at the southern tip of the island, represents an area that Hawaii County has expressed interest in developing as a recreation area, due to its scenic character and its popularity as a fishing area. Development of launch facilities would be inconsistent with Hawaii County's general plan and their desire to use the area for recreation. As a result, development of ALS facilities at Ka'Lae would create high visual resource constraints.

Rockwell

Rockwell proposes the development of launch facilities at Palima Point. Constraints to Rockwell's proposal would be similar to that for Martin Marietta Corporation/McDonnell Douglas at Palima Point.

3.8 CULTURAL

3.8.1 Affect Environment

3.8.1.1 West Coast

Vandenberg AFB is located in an area historically occupied by the Purisimeno Chumash. The Chumash Indians who occupied the southern California coast had a high degree of complexity of social and economic organization that they developed while relying on a subsistence base of hunting, gathering, and fishing. Early ethnohistoric accounts by Spanish explorers and missionaries described the Chumash way of life as one involving a hierarchical organization of large semi-sedentary villages, craft specialization, and a regional system of exchange involving the production, control, and use of shell beads as money. How this complex cultural system arose is poorly understood, but most agree that it evolved from a much simpler "Early Period" system based on small, relatively mobile residential groups who moved in concert with the changing distributions of different, seasonably available resources. Sites on VAFB range from a 9,000 year old Early Period site to large villages visited by the Spanish in the 17th Century.

Archaeological research has contributed much to our understanding of the patterns of subsistence and settlement, as well as the social and economic systems which characterized the Chumash of the Channel Islands and the coastal mainland south of Point Conception. The Chumash of other areas are not as well known. Very little is known about the Purisimeo Chumash who occupied the coast between Point Conception and north of the Santa Maria River; it is this area that might be affected by the ALS project.

The region north of Point Conception is environmentally quite different from that of the south. The coast is more exposed, the surf rougher, the water colder, and the climate is generally less hospitable. Given the dependence of the Island Chumash and the Barbareno Chumash on fish and other marine resources, it is not well known how restricted access to these resources have affected the Purisimeno Chumash. Many archaeological sites on VAFB have the potential to yield important scientific data that can help answer regional settlement and subsistence research questions.

The density of coastal sites on VAFB is one of the highest in North America. As a result, ground-disturbing projects like ALS would require extensive archaeological surveys, test excavations, and data recovery mitigations to comply with the National Historic Preservation Act as implemented by 36 CFR 800 (guidelines promulgated by the Advisory Council on Historic Preservation).

The only major studies of subsistence and settlement for the Purisimeno region include the M-X Missile Archaeological Project (Chambers Consultants and Planners 1984) which involved 60 archaeological sites on San Antonio Terrace (a coastal dune area north of San Antonio Creek) and the Union Oil pipeline project (URS 1988) which resulted in the investigation of 23 prehistoric sites located in the Santa Ynez River Basin. The results of these studies suggest that the Chumash north of Point Conception may indeed have differed significantly from those to the south, practicing a more mobile, more terrestrially-oriented subsistence strategy and using a combination of seasonal base camps and satellite resource procurement sites to exploit the local resources. Prehistoric and ethnohistorically known villages containing cemeteries, houses, and other features occur but are relatively rare.

Archaeological records on file at VAFB and the California Archaeological Site Survey Regional Office at UC Santa Barbara indicate that much of the South VAFB area proposed for ALS use has not been professionally surveyed with modern archaeological techniques. Nonetheless, over 40 archaeological sites have been recorded in the coastal strip east and south of SLC-6, including the Point Arguello Harbor area, Sudden Flats, the Sudden vicinity, and adjacent areas. These sites include three large villages, (two of which contain cemetery areas and very high densities and diversities of artifacts), smaller occupation sites, prehistoric quarries, lithic and shell scatters, and several historic archaeological sites. Professional survey in these areas could locate additional sites.

Other areas of VAFB that may be affected by ALS include the bluffs on either side of the Santa Ynez River, parts of Burton Mesa and the San Antonio Terrace. These locations have been partially surveyed and they are characterized by relatively high densities of archaeological sites ranging from a 9,000 year old base camp to small artifact scatters deposited over the last 300 to 500 years.

It is important to note that local Chumash and other Native Americans are highly concerned about impacts to archaeological sites. They will be concerned about and require participation in cultural resource investigations that could occur as a result of ALS development. VAFB has a long history of involvement with Native Americans from the nearby Santa Ynez Indian Reservation. Native Americans are routinely consulted about cultural resource investigations and usually serve as monitors during archaeological excavation projects.

3.8.1.2 East Coast

The CCAFS and KSC area have been occupied for 7,000 years. Physical evidence for prehistoric people is in the form of shell middens and lithic tool scatters. The earliest people on the Florida peninsula are represented by the Paleo-Indian Stage. There is, however, little evidence of their use of the project area.

Occupation of the area was sporadic during the Early Preceramic Archaic Stage (6,500 to 4,000 B.C.). It appears that the Indian River area was visited frequently during the Late Preceramic Stage (5,000 to 1,000 B.C.), but there may not have been permanent settlements in the area (Milanich and Fairbanks 1980:150). The sites from this Period are often characterized by shell mounds of snail shell. The first permanent occupation of the area was during the Transitional Stage as exemplified by the Orange Period sites (1200 to 500 B.C.). It is during this period that pottery came into use. The Transitional Stage is followed by the Formative Stage as noted in the archaeological culture referred to as the Malabar (500 B.C. to A.D. 1565, Rouse 1951). The Malabar is broken down into six phases. The last, Malabar IIC, is the earliest period of contact with Europeans.

The ethnographically known Malabar IIC inhabitants were the Ais Indians, who were hunters and gatherers. These people occupied the area along the Atlantic Coast region and the Indian River Area from Cape Canaveral to the St. Lucia River (Levy, Barton, and Riordan, 1984). The Ais had a major village called Ulumay which was located on the Banana River portion of the Cape. Another group of people in the area in historic times were the Timucuan Indians who lived between the Georgia/Florida border and Cape Canaveral. Depredations to the population due to war and disease caused the cultures to be extinct by the early 1600's (Campbell, Thomas, and Weed, 1982).

The first European explorers to visit the region were the Spanish. Ponce de Leon is credited with discovery of Florida. By 1513 European maps showed Cape Canaveral (Cap of the Cane Breaks) on them. There is little evidence of Spanish occupation in the Cape Canaveral area.

After the Nine Years War, England gained Florida from Spain. English colonists arrived in 1768 and established a settlement at Smyrna Beach. Much of the English occupation seems to have occurred north of the study area. English influence in the area came to an end after the American Revolution and Florida was ceded back to Spain. In 1821 Spain sold Florida to the United States. The first citrus grove was planted in 1818 by Colonel Thomas Dummitt. In 1856 the Community of Canaveral was established.

There are approximately 80 recorded sites located within the KSC/Cape Canaveral area. They range in size from small prehistoric scatters to large prehistoric settlements (over 300m long); and to historic sites including homesteads, dump areas, Canaveral townsite and lighthouses. Areas considered historically significant which are related to the "Man in Space" National Historic Landmark Program include the Mission Control Center and complexes 5/6, 26, 34, 13, 14, and 19, which were used during the Mercury and early Gemini manned space flights. The VAB and launch pad at LC 39 are in the National Register of Historic Sites and Places as are two historic lighthouses. A memorandum of agreement (MOA) is in effect covering LC 39. A programmatic MOA is currently being developed to replace the existing agreement. According to Louis Tesser (Florida Department of State, Division of Historical Resources) discussions are being carried out on the means to protect and deal with cultural resources on KSC and may begin with CCAFS. All cultural resources in areas of the ETR to be affected by any proposed action must be addressed under 36 CFR 800.

An archaeological/historical survey of portion of CCAFS was conducted in 1984 by Resource Analysts, Inc. The survey included document review, background searches and field surveys. The study identified 32 prehistoric and historic sites, many of which have been damaged by construction of roads, launch complexes, and power lines. Eleven sites were recommended for further evaluation to determine eligibility for inclusion in the National Register of Historic Sites and Places.

3.8.1.3 Hawaii

Available documentation used in this analysis include the draft Hawaii County General Plan (1987) and Selection Of A Location For A Space Launch Facility In Hawaii (ADL 1988). Data contained in these documents are general but they are sufficient for the present purposes of this document.

Archaeological evidence suggests the big island of Hawaii was first settled by Polynesians who landed at Ka Lae sometime around 700 to 800 A.D. This area is considered sensitive, particularly by native Hawaiians. Early settlers first established small fishing villages but eventually agriculture became an important subsistence activity as well. Population increased and coastal and inland areas throughout the island were settled. Over 10,000 sites have been recorded and there may be a total of 100,000 to 300,000 sites on the island.

Significant historic events in the southeast part of the island, called the Ka'u district, include the killing of Chief Keoua as he was dedicating the sacred Pu' ukohola Heiau in 1791. With this killing, Kamehameha gained control of the Ka'u district and became the unifier and ruler of the entire island. Later, Ka'u became a stopping point for sea-faring travelars bound for Hilo. Mark Twain lived in the district for some time and wrote extensively about the beauty and the people of the Hawiian Islands.

Ka'u has not been well surveyed for archaeological sites but general patterns of site distribution can be described and some areas are well known. The highest density of sites appears to be located in the Ka Lae area. Not only was this area first settled but its deep soils were agriculturally productive and local population levels were high. The highest density of sites occurs 1/4 to 1/2 mile from the coast but large numbers of farm plots, trails, boundary markers, and other sites can be found along the coast as well as 3 to 6 miles inland (Cordy, personal communication). Although there has been a little archaeological survey in the vicinity of Kahilipali Point, existing data indicate this area also contains a high density of sites (Cordy, personal communication). Known sites include a major heiau, petroglyphs, and a variety of prehistoric and historic walls (ADL 1988).

Other parts of Ka'u appear to have lower densities of sites. Even so, the ADL (1988) survey of of Palima Point and adjacent coastal areas located over 30 sites, including the Kaneeleele heiau complex and smaller settlements containing stepping stone trails, petroglyphs, canoe sheds, burial platforms, lava tube sites, and a wide variey of habitation structures (ADL 1988). The ADL survey did not extend into inland areas but unrecorded sites are known to occur there as well.

Native Hawaiians in the Ka'u district are concerned about preserving cultural resources and 50 percent or more are thought to strongly oppose development in the area under consideration for ALS use (Cordy, personal communication).

3.8.2 Environmental Consequences

Environmental consequences of all proposed alternatives were assessed by:

- mapping project components against known and predicted locations of cultural resources;
- determining the number, nature, and probable integrity of resources that might be affected;
- assessing the potential significance of these resources, as defined by criteria for listing on the National Register of Historic Places (36 CFR 60.6);
- assessing the cultural value of these resources and the potential for Native American concerns based on personal experience, SHPO contact, and by considering criteria described in Guidelines for Consideration of Traditional Cultural Values in Historic Preservation Review (Advisory Council on Historic Preservation, 1985 draft);
- evaluting the potential for resource avoidance; and
- assessing potential cost and schedule requirements of cultural resource studies that may be required by the various project alternatives.

3.8.2.1 West Coast

Boeing

Boeing would use VAFB only for the expanded mission and 4080 acres would be required for the P/A module landing area. SLC-6 would be modified for use and new crawlerways would extend to new ALS facilities at Sudden Flats. SLC-7 (if built) is proposed as a backup launch facility. New construction proposed by Boeing could disturb a minimum of 38 acres in the Sudden Flats vicinity. As many as 10-20 known archaeological sites, including a major village (SBa-210), could be disturbed or destroyed during construction. Some sites certainly can be avoided but, in general, the potential for avoidance is low because some sites are clustered in areas of impact, and some sites are large and extend from the coastline to the foothills and would be crossed by any road going down the coast. There is also a low to moderate probability that buried sites could be uncovered during construction. If currently defined site boundaries are correct, it may be impossible to avoid SBa-210. This large, multi-component village site was occupied during the early period of Spanish exploration. This village, described in Spanish records as Nocto, has been determined to be 5 to 6 m deep and one of the largest shell midden sites on VAFB. It also contains a cemetary. If burials are encountered in this village, schedules could be affected.

Overall, sites in the Sudden Flats vicinity are thought to have good integrity, although some portions of some sites have been affected by roads, the railroad, firebreaks, and/or cultivation. Given other space-related facilities and the developments in the area, ALS facilities would probably not affect the setting of local sites but the scientific significance of the sites is rated as high and local Native Americans will be extremely concerned about potential impacts.

Boeing also also proposes a propulsion/avionics (P/A) module landing area somewhere on San Antonio Terrace. This use would require leveling and clearing of a six-square mile area, which could affect about 60 archaeological sites (site densities on San Antonio Terrace are around six sites per sq km). Sites in the area exhibit good integrity and the research potential of the area has been recognized by the recent nomination of the Terrace as a National Register

Archaeological District. Native Americans would be highly concerned, particularly given the large numbers of sites that would also be affected in South VAFB.

Given the proposed use of the San Antonio Terrace in combination wth the use of Sudden Flats and adjacent areas Boeing's proposal (and that of UTC-see below) will result in more impacts to cultural resources than any other proposal for the expanded mission. The greatest contributing factor in this ranking is the large amount of land disturbance associated with preparing an area for the recovery of the P/A module.

General Dynamics

General Dynamics proposes to use VAFB for both the normal and expanded missions. Only a land launch alternative is proposed. Construction of all new facilities in the Sudden Flats area would disturb a minimum of 35 acres of land. Project components include launch facilities west and southwest of Round Hill, a SRM rail storage siding, and ALS integration facilities located near Jalama Beach almost 4 miles from the launch facilities. A new crawlerway will presumably connect the overall system.

Both the normal and expanded missions would result in impacts to sites in the Sudden Flats area that would be generally similar to those described above for Boeing's expanded mission. Both contractor proposals would affect the large village SBa-210 and a number of smaller sites. In fact, most proposals would result in fairly similar levels of impact and constraint in the Sudden Flats area but General Dynamic's proposal is unique in that construction of the integration facilities and connecting crawlerway would affect additional areas to the southeast. At least two additional prehistoric villages would be disturbed and additional sites would probably be located with further archaeological survey. The General Dynamics proposal will thus create more cultural resource impacts in this part of VAFB than any other proposal, except for Martin Marietta Corporation/McDonnell Douglas (see below).

General Dynamics would construct a manufacture/final assembly facility building on North VAFB. Transporting materials to the integration and launch complexes would probably require a new road and a new bridge across the Santa Ynez River. The integrity of sites that could be affected by construction of the building would probably be low and site density in this part of the base is relatively

low. However, the road system and bridge have a high probability of affecting sites because the terraces along the Santa Ynez River contain a relatively high density of prehistoric sites. More detailed siting data will be required to provide a more concrete assessment of impacts and constraints for this component of this proposal.

General Dynamics also proposes to widen and pave an existing dirt road between Lompoc and the processing facilities. Although existing data are limited for this corridor, the route crosses two springs and follows San Miguelito Creek for several miles. Small base camps, temporary camps, quarries, small lithic scatters and other limited activity sites should occur. Inland sites have not received much investigation and these sites would be considered potentially significant and would warrent investigation. The proposal also suggests rerouting the Southern Pacific Railway far to the east. The exact route is not well defined but relatively large numbers of archaeological sites would undoubtedly be disturbed or destroyed by the reroute.

The only proposals that could affect more cultural resource sites than the General Dynamics proposal are those of Boeing and UTC (see below), which require the disturbance of an enormous amount of land for recovery of the P/A module. On the other hand, the General Dynamics proposal would affect a wider variety of sites because it would result in the disturbance of a greater number of environmental zones. General Dynamics' proposal would also affect a greater number of large villages that would be expensive to investigate and create high levels of concern among Native Americans.

Martin Marietta Corporation/McDonnell Douglas

Martin Marietta Corporation/McDonnell Douglas propose land, near-shore, and off-shore launch options at VAFB for both normal and expanded missions. They also propose offshore launch facilities based at Port Hueneme, near Oxnard, California. The Port Hueneme option would require expansion of the port but constraints would be low because most (if not all) of the area that would be affected is fill. Cultural resource investigations required by this option would be low. There would not be any significant concern on the part of local Native Americans.

The VAFB options are roughly similar in constraint (high) because they all locate launch facilities in the Sudden Flats area and require fairly long roads in the coastal zone

which would affect a number of sites, including tne large village SBa-210. Additional survey will undoubtedly locate more sites in this area.

Although all three options at VAFB are given a high constraint rating, they are expected to differ in the number of sites affected. The land option would entail the greatest amount of ground disturbance in the boathouse and Sudden Flats areas and would probably affect the greatest numbers of sites. The offshore option would disturb the least and the near-shore option falls somewhere in between. Native Americans would be concerned about impacts, particularly in the case of SB-210.

Rockwell

Rockwell proposes to modify launch facilities at SLC-6 for both the normal and expanded missions. The facilities would be connected with a crawlerway to the ALS complex located in the Sudden Flats area. The expanded mission would require construction of new launch facilities near the ALS complex.

Impacts from the normal mission would be high in constraint due to the above-noted sensitivity of this part of VAFB. However, in comparison to normal mission configurations proposed at VAFB by other contractors, Rockwell's proposal should create the lowest impacts.

Rockwell's expanded mission will require all new facilities in the Sudden Flats area and constraints will be high. Impacts will be similar to those described for the expanded mission configuration proposed by Martin Marietta/ McDonnell Douglas and lower than expanded mission configurations proposed by Boeing, General Dynamics, and UTC. Whereas Rockwell's configuration is restricted to the Sudden Flats area, configurations put forth by the other contractors will affect other areas as well.

United Technologies Corporation

United Technologies Corporation proposes facilities at VAFB for both mission concepts, and launch facilities are proposed in the Sudden Flats area. The launch complex will be connected to ALS facilities located in the boathouse area. The sensitivity of this part of VAFB has been described above and this proposal is given a high constraint rating. Impacts to this area will be similar to those described for other contractor proposals, but UTC, like Boeing, proposes to clear a six-square mile area for land

recovery of the P/A module. This component increases the level of impact for these two contractors to an exceptionally high level and their proposals have by far the highest constraint. Because UTC proposes to create a P/A landing area for both the normal and expanded missions, and Boeing only proposes one for the expanded mission, UTC can be described as having the highest constraint of any proposal.

3.8.2.2 East Coast

The ALS may have both direct and indirect impacts on cultural resources. Construction of new facilities, enhancement of old facilities, extension of, or improvements to infrastructure (roads and utility lines) may result in impacts to cultural resources. If quarry materials are required to prepare project sites, or roads need to be constructed or expanded, then there is the potential for off-site impacts.

The following is a brief assessment of potential impacts which could result from the five basic concepts.

Boeing

Their concept involves uses of LC 37 and LC 34 with Complex 6. If this requires new building construction or the expansion of the infrastructure, then there is the possibility for impacts to cultural resources. Boeing's use of a P/A landing area of six-square miles may result in impacts to a significant number of cultural resources.

General Dynamics

They are proposing using LC 37 and LC 34 with processing at CCAFS Industrial Base. If this requires new building construction or the expansion of infrastructure then there is the possibility for impacts to cultural resources.

Martin Marietta Corporation/McDonnell Douglas

Due to the specific nature of the concept layout it appears that there is the potential for the following impacts:

1) Integration and Launch Complexes, archaeological sites possibly affected: BR147-149, 151, 205 and LC 39 National Register Site;

2) Manufacturing Complexes, archaeological site possibly affected: BR61;

3) Off-shore Assembly Integration Area, archaeological sites possibly affected: BR219-221, BR82.

Rockwell

Their concept calls for construction of a new launch pad in the area of LC 39 and basic infrastructure support facilities. With the construction of new facilities and pad coupled with incomplete survey information on KSC there is a strong probability that cultural resources will be affected by the Rockwell concept. LC 39 is a sensitive National Historic Register location and any proposed action could well require the pertinent review under the existing MOA.

United Technology Corporation

Their concept proposes to upgrade existing facilities and to construct a two nautical mile diameter P/A module recovery area. There will be potential impacts to facilities which are part of the National Historic Landmark Program, specifically complexes 13 and 19. If new infrastructure items are required, or the facilities expanded as part of the upgrade, then assessment of impacts will be required. Depending on the location of the P/A module recovery area, there is the potential for impacts to significant cultural resources.

3.8.2.3 Hawaii

Martin Marietta Corporation/McDonnell Douglas

This contractor proposes land launch at Palima Point, Kahilipali Point, and Ka'ae. Offshore launch is also proposed for Palima Point.

Construction at Ka Lae and Kahilipali Point would impact an unknown but relatively large number of archaeclogical sites. Integrity of these sites is expected to be good and many are likely to be scientifically and historically significant. These sites, particularly in the Ka Lae area, may be collectively eligible for listing as a National Register District and Ka Lae is already the location of a number of archaeological sites already on the National Register. ALS construction would affect the setting and integrity of the archaeological sites in both the Ka'Lae and Kahilipali areas. Burial sites could be affected and many Native

Hawaiians are likely to be vocally opposed to the project. These two siting areas therefore are given a high constraint. Cost and schedule requirements for any cultural resource investigations that might be required cannot be assessed until futher study.

Palima Point is less sensitve to impact because it has a lower density of sites and may not have the importance to Native Hawaiians that the other siting locations seem to have. The land launch option could affect several coastal sites but avoidance is probably possible (ADL 1988). Interior sites could be affected but they should be small in number and costs and schedule requirements should be relatively low. The offshore option may be slightly more sensitive because facilities would be required at the coast where several sites are located. All Palima Point options are viewed as moderate in constraint.

Rockwell

This contractor proposes a land launch at Palima Point which would be similar in constraint to the Martin Marietta Corporation/McDonnell Douglas proposal noted above.

3.9 SOCIOECONOMICS

Construction of new facilities and operations associated with ALS would have socioeconomic consequences for each of the three proposed sites. This section provides a brief overview of existing conditions at the sites. Emphasis is placed on employment, population, and housing -- typically the issues of greatest concern in socioeconomic impact analysis.

3.9.1 Affected Environment

3.9.1.1 West Coast

Vandenberg Air Force Base is located in the northern portion of Santa Barbara County, California. Population in the county in 1988 is an estimated 345,000 persons. In the future the county population is forecast to increase moderately, to 353,000 by 1990 and 367,000 by 1995. Much of the population growth in recent years has occurred in the north county, stimulated by low housing costs and employment opportunities at VAFB.

The unemployment rate in Santa Barbara County is currently 4.6 percent, having declined from almost 6 percent in 1985. Unemployment is much higher, currently exceeding 7.5 percent, in the north county cities of Lompoc and Santa Maria. The higher rates in the north county area are largely attributable to the layoff of aerospace workers at VAFB following the Challenger accident.

Lompoc considers itself a pro-growth community with resources to accommodate a greatly expanded mission at VAFB. According to King Leonard, Director of the Lompoc Community Development Department, sixty percent of the total housing units in the city are renter-occupied, with a vacancy rate of 15 percent in multi-family units. Like housing, schools in the area have excess capacity because of the out-migration of aerospace workers.

Santa Maria also considers itself pro-growth. Greg Villegas, a planner with the Santa Maria Community Development Department, foresaw no major constraints to increasing activity at VAFB by the amount suggested by the ALS proposals.

3.9.1.2 East Coast

Cape Canaveral Air Force Station (CCAFS) and Kennedy Space Center (KSC) are located in Brevard County, Florida. The population of the county has been growing rapidly, from 273,000 in 1980 to 338,000 in 1985, and is expected to increase to 407,000 by 1990.

The unemployment rate for the county has been decreasing since 1985 and is currently 4.7 percent. However, the construction sector experienced a loss of approximately 300 jobs in the last year. Discussions with Charles Johnson, an economist with the Job Service of Florida, indicated that there would be sufficient local labor for both construction and operation phases of the ALS.

The local area surrounding CCAFS and KSC is prepared for continued economic growth, as recognized in the Brevard County Comprehensive Plan. According to Susan Cossey, the executive director of the Economic Development Council of the Cocoa Beach Area Chamber of Commerce, there is housing available and excess capacity in community services sufficient to meet the needs of ALS construction and operation.

3.9.1.3 Hawaii

Proposed ALS launch facilities would be located near Palima Point, on the Southeastern coast of the island of Hawaii. The population in the county of Hawaii was approximately 112,000 in 1986, and is forecast to grow to 125,000 by 1990.

The unemployment rate for the island fell from 7.9 percent in 1986 to 4.7 percent in 1988, a decline driven by growth in tourist-related services on the north side of the island. Unemployment for communities on the islands south side is estimated to be considerably higher.

While Hawaii is experiencing a boom in hotel construction and tourism, local and state official are hoping to attract other industries which would better balance the structure of the island economy. Currently the socioeconomic resources of the island are nearing their limits. The recent increase in tourist-related activity has greatly reduced available housing. Donald Tong of the Hawaii County Planning Department felt that any in-migrating workers related to the proposed project would tax local public services, schools and housing.

3.9.2 Environmental Consequences

Constraints related to socioeconomics include potential impacts on:

- o employment
- o population
- o housing.

The socioeconomic impacts of the ALS would be largely a function of in-migrating workers and local expenditures for services and materials. These workers and expenditures would also have an indirect effect as they generally stimulate the local economy and create additional jobs and expenditures.

The ability to accommodate project material requirements and meet labor requirements from the local labor force will determine the relative impact of the project at different sites. While data is not available to compare the socioeconomic impacts for each contractors proposal, labor and material estimates provided by Rockwell and Boeing permit preliminary comparisons of project impacts across sites. These are "worst-case" comparisons based on estimates of total (direct and indirect) employment and expenditure impacts. All financial impacts are expressed in 1988 dollars.

3.9.2.1 West Coast

Under the expanded mission model proposed by Boeing, a new launch pad would be constructed at VAFB, and SLC-6 and possibly SLC-7 used as backup pads. No major manufacturing would take place on the WTR. The total economic impact of ALS construction and operation within the two-county region (Santa Barbara and San Luis Obispo counties) would be $1.2 billion. Total economic impact is defined as the total (direct and indirect) sales and earnings attributable to the project.

Peak employment at the WTR would occur in 1996, with 1,960 workers directly related to ALS construction and operations. The total employment impact, including direct and indirect workers, would be 5,292 new jobs in the two-county region. This is roughly equivalent to the layoffs following the Challenger accident. Some portion of the new jobs will be filled by in-migrants but, given the high unemployment among

local aerospace workers, it is likely that many will be taken by workers already residing in the region. The impact of in-migrating workers would present a low to moderate constraint to implementing the ALS at VAFB. The peak-year population impact is estimated at 13,230 people (5, 292 direct and indirect workers plus families).

3.9.2.2 East Coast

Under the expanded mission model, Boeing has all vehicle production and most launches occurring on the ETR. Over the period 1990 to 1998 this would amount to roughly $3.2 billion in labor and material expenditures within a three county (Brevard, Indian River, Osceola) region.

Peak employment impacts according to this scenario would occur in 1998, with much of the project work force involved with the fabrication of reusable rocket components. This effort in addition to launch operations and facilities construction would involve 21,000 direct and indirect workers in the three county region. Many of these workers might be drawn from the local labor force. However, with full employment in the region the project labor demand could require a large number of in-migrants into the region. If all workers in-migrated with their dependents the total population impact would be 52,000 persons, roughly a 10 percent increase over the 1990 population projected for the region. Despite the assurances of local planners such an impact would present at least a moderate constraint to implementing the ALS.

3.9.2.3 Hawaii

According to one option in the Rockwell proposal, all launch facilities would be constructed at Palima Point. This would amount to a total impact to the island economy of $510 million. This estimate does not include production or operation costs, and thus is considerably lower than impacts estimated for east and west coast sites.

Peak year employment impacts are not available, but an average 500 construction workers would be required over an extensive period of time. Adding a rough estimate of 200 operations workers would increase the number of direct project workers to 700. Including indirect workers would increase the total employment impact to 1,260 workers. If all of these workers migrated to Hawaii with their

households, the total population impact would be roughly 3,150, or a 2.5 percent increase over the 1990 projected population.

Currently, there is no infrastructure in place to support the development of Palima Point. Unpaved roads provide the only land access to the area, and it is currently not served by utilities. The undeveloped nature of the site would require a considerable investment in infrastructure.

Considering the limitations of current housing, schools, and public services, it is likely that potential socioeconomic impacts would be a high constraint to the ALS development on the island.

3.10 HEALTH AND SAFETY

Health and safety concerns of the ALS are divided into two general areas, safety and toxic hazards. Safety includes hazards or limitations associated with flight corridors and vehicle re-entry and recovery, whereas toxic hazards are those associated with hazardous chemical use, transportation, storage and release, and the generation of hazardous wastes.

3.10.1 Affected Environment

The affected environment as it applies to health and safety issues includes, flight safety; proximity to population and public transportation to evaluate range safety and toxic exposure hazards; proximity to hazardous chemical suppliers and hazardous waste facilities to evaluate transportation hazards; and availability of hazardous waste treatment/ disposal facilities. Since all contractors propose both east and west coast launch sites with generally the same health and safety constraints, the affected environment is only briefly discussed for comparison of VAFB and CCAFS/KSC to Hawaii and sea-based launches proposed by only two of the contractors.

3.10.1.1 West Coast

Santa Barbara County and subareas had an estimated population of 349,000 in 1988 (Section 3.9.1.1), with approximately 151,000 in the North County and 194,000 in the South Coast. Located within the caution corridor (where the risk of injury is less than one in one million) are oil platforms, a public railroad, ranches, potential development sites, and Jalama Beach. All of these must be evacuated prior to launch (VAFB, 1988).

The acceptable range for flights from SLC-6 at VAFB are more restricted than CCAFS/KSC and Hawaii and are shown in Figures 6 and 14. Launching vehicles from new facilities at Sudden Flats and/or SLC-6, as all contractors propose to eventually do, would further restrict flight azimuths due to proximity to Bixby and Hollister ranches and Jalama Beach.

Two suppliers of liquid hydrogen are located in California. They would require expansion to supply the needs created by the ALS launch schedule. Liquid oxygen facilities are sufficient to meet the needs of the program.

There are several hazardous waste treatment/disposal facilities in California. The closest, Casmalia Resources, is three miles from Vandenberg, and Kettleman Hills is 120 miles from Vandenberg. Vandenberg has wastewater treatment facilities on-site for the neutralization/treatment of the hazardous wastewaters produced from sound suppression, flame deluge, wash down and refurbishment of recoverables.

3.10.1.2 East Coast

CCAFS and KSC are located in Brevard County, which had a population of approximately 338,000 in 1985 (Section 3.9.1.2). Residential and commercial development is concentrated along Interstate-95 and US-1. The nearest public road is approximately five miles away. There are no oil platforms, public transportation lines, or privately owned land within the caution corridor. CCAFS technical support facilities are located within two miles of the proposed launch pads (CCAFS, 1986). The acceptable range for flights from the proposed launch sites are shown in Figure 6.

The nearest supplier of liquid hydrogen is located in Louisiana, though it could not meet the needs of the ALS launch schedule without expansion. Liquid oxygen facilities are available that could meet the needs of the program.

The nearest hazardous waste treatment/disposal facilities are located in South Carolina and Alabama. KSC has wastewater treatment facilities on-site for the neutralization/treatment of hazardous wastewaters produced from sound suppression, wash down and refurbishment of recoverables.

3.10.1.3 Hawaii

The three proposed Hawaii launch sites are located in Hawaii County, which had a population of approximately 112,000 in 1986 (Section 3.9.1.3). The Kau District of Hawaii County, which also contains all three sites, has a population of approximately 3000. In addition to this permanent population, the Hawaii Volcanoes National Park, whose nearest boundary is less than one mile northeast of Palima Point, receives approximately 2,800,000 visitors per year (Hawaii Volcanoes National Park, 1985).

The flight azimuths and the caution corridor for the three proposed Hawaii launch sites are shown in Figure 3.1. The off-shore portion of the caution corridor would have to be cleared prior to launch.

The nearest suppliers of liquid hydrogen and liquid oxygen are located in California. There are no existing facilities for the storage of these fuels. Since the transportation of the fuels is over a great distance, larger storage facilities than for VAFB or CCAFS/KSC would probably be required or the construction of new on-site production facilities.

There are no hazardous waste treatment/disposal facilities in Hawaii, though there is a storage/transfer facility on the island of Oahu. The nearest treatment/disposal facilities are located in California. There are no facilities available for the treatment of hazardous wastewaters produced from sound suppression, flame deluge, wash down and refurbishment of recoverables.

3.10.2 Environmental Consequences

All of the contractors propose the potential use of both VAFB and CCAFS/KSC. The hazards and safety limitations associated with launching vehicles from these sites, such as flight azimuths, impact limit lines, toxic corridors, etc., will generally be the same for these concepts. Since all of the contractors propose multiple configurations, some of which are more hazardous than others, the first part of this section discusses health and safety constraints of various configurations which all the contractors proposed. However, it should be noted that some of the contractors emphasized a particular configuration even though other configurations were mentioned, for example, UTC strongly proposed the use of solid boosters (SRB) even though liquid boosters are also mentioned.

All concepts propose the potential use of SRB and all require the use of a liquid fueled (LO_2/LH_2) core vehicle and hypergolics for orbit maneuvering and control systems. All SRB contain HCl, thus the health and safety constraints are significant, even though the proposed SRB contain less than 3% by weight of exhaust products and are relatively safer than previous SRB which contained 15%. However, the toxic hazards involved in the production, transportation, storage, assembly and launch associated with the SRB will be

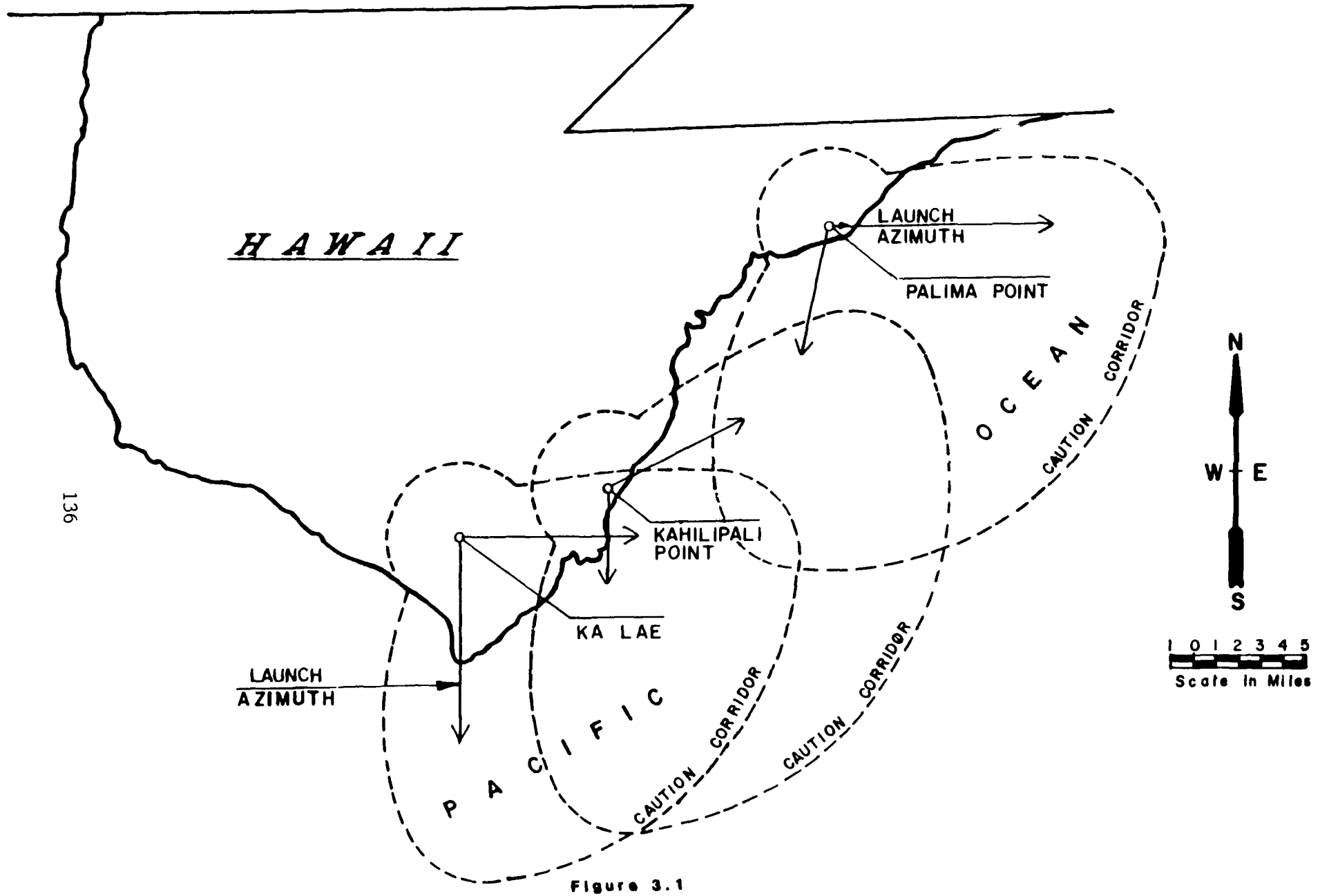


Figure 3.1

HAWAII LAUNCH SITE CAUTION CORRIDORS

the same for all five concepts. The flight safety of SRB is also less than liquid boosters since the SRB have an increased likelihood of landing intact during re-entry.

The hypergolics for payloads contain hydrazine, monomethyl hydrazine, or dimethyl hydrazine, and nitrogen tetroxide, all of which are highly toxic. The hypergolics are burned in orbit and the only environmental release is during fueling or a catastrophe during transportation, storage, assembly, or launch. The same hazards would be involved for all concepts.

The liquid fuels have less health and safety constraints than solids, since they contain no HCl and thus do not produce a potentially toxic launch cloud nor hazardous (corrosive) wastewater. Since liquid hydrogen is explosive there are hazards associated with the transportation and storage if an accident were to occur. Accordingly, west coast launches nearer to suppliers involve less transportation hazard than east coast launches, and both east coast and west coast have less transportation hazards than Hawaii.

The structural and insulation materials are similar for all concepts. Contaminants from the structure enter the deluge water and largely consist of aluminum, aluminum-lithide, and pain chips. Deluge wastewater from the space shuttle has shown detectable concentrations of aluminum, iron and zinc (personal communication - Mario Busacca, July 19, 1988). Additional hazardous wastewater is generated during the refurbishment operations where burn residues and insulation materials are stream-stripped from the recoverable boosters.

The volumes of hazardous waste generated per launch are likely to be less than the space shuttle (approximately one fourth for liquid boosters to one half for SRB for launch pad wastewaters) which for the shuttle were estimated as follows (VAFB, 1983).

Launch Pad Wastewaters	1,5000,000 gal
SRB Disassembly and Refurbishment Wastewater	1,000,000 gal
Orbiter and Hypergolic Maintenance Wastewater	4,000 gal
Solid Hazardous Waste	7,400 lbs

Vandenberg AFB has better accessibility to RCRA-permitted hazardous waste treatment facilities than KSC, which has better accessibility than Hawaii. Both KSC and VAFB have launchpad-wastewater neutralization facilities on-site.

There are some differences in vehicle configuration, particularly component recovery, that may marginally affect health and safety constraints. The flyback booster will make one orbit then return to a runway. During deorbit and return flight it will be under remote control. If control over descent is lost a safety hazard will result. P/A modules return via parachute to either a water or a land-based landing site after a single orbit. Significant hazards will result if the parachute fails to deploy. These are discussed below by contractor. Additional differentiating factors for health and safety constraints among the contractors' concepts are a result of proposed Hawaii launch sites by Rockwell and Martin Marietta Corporation/McDonnell Douglas.

Boeing

The Boeing recovery configurations consist of fly back boosters, recovery of the P/A module on land via parachute and recovery of the liquid booster P/A module in the ocean. The fly back configuration is considered safer than the parachute landing on land since its landing is more predictable.

General Dynamics

General Dynamics does not propose to recover the core P/A module, nor do they propose fly back boosters. This eliminates landing hazards, though it creates more debris falling into the ocean. The P/A module from the liquid boosters would be water recoverable.

Martin Marietta Corporation/McDonnell Douglas

Martin Marietta Corporation/McDonnell Douglas does not propose to recover P/A modules from the core or the boosters, however, a flyback booster is proposed. The flyback option reduces the amount of debris that would fall into the ocean.

Martin Marietta Corporation/McDonnell Douglas propose Hawaii launch sites and sea-based launch sites in addition to east coast and west coast land launch sites. The locations of the proposed Hawaii launch sites are Palima Point,

Kahilipali Point and Ka'Lae (South Point). In a previous study for the location of a space launch facility in Hawaii (State of Hawaii, 1988) these three sites were analyzed with regard to health and safety impacts.

1. Palima Point: safety, operational and performance criteria are acceptable. A site can be identified such that population and development would be excluded from the caution corridor and the population control zone. During periods of strong easterly or on-shore winds, launch holds might be required. Assessment of the potential impacts downrange indicates no problems with respect to the air and shipping lanes. International airspace and sea area conflicts can be resolved through scheduling techniques in place in the Pacific area.

2. Kahilipali Point: Safety, operational and performance criteria are acceptable. No homes were identified within the caution corridor. Within the population control zone there are several homes in a subdivision, an indication of further development. Assessment of the potential impacts downrange indicates no problems with respect to air and shipping lanes. International airspace and sea area conflicts can be resolved through scheduling techniques already in place in the Pacific area.

3. Ka'Lae (South) Point: Sites in this area face safety constraints. Either equatorial launches would have to be made on an azimuth to avoid overflying population, or greater than 30,000 acres of land would need to be controlled.

The flight and range safety constraints for Palima Point and Kahilipali Point are significantly less than they are for VAFB and CCAFS/KSC due to the remoteness of location. The Volcanoes National Park is a potential safety constraint associated with Palima Point due to the high visitor use of the area.

Though the flight and range safety constraints are minimal, there are some constraints associated with toxic hazards. Since the population is very small and not closely located to the proposed sites, compared to ETR and WTR, there are less operational toxic exposure risks. However, transportation of hazardous materials to the site, i.e., hypergols and fuels, would be a significant constraint since they would have to be imported from the mainland. To make

these health and safety constraints comparable to ETR and WTR, fuel production facilities would need to be located on the island.

There are no hazardous waste treatment or disposal facilities in Hawaii, and all hazardous wastes would require shipment to California for disposal. As with fuel production, to make these constraints comparable to ETR and WTR, hazardous waste treatment facilities would be required at a minimum for the launch pad wastewater.

In addition to the land-based launch facilities that Martin Marietta Corporation/McDonnell Douglas propose for Hawaii, ETR, and WTR, a variety of sea-based launch options are proposed. The near-shore options proposed at ETR and WTR have comparable flight and range safety constraints as the land launches from these sites. The toxic hazards would be slightly less since the launch sites are further from populated areas. Less hazardous waste would be generated since the launch pad wastewater would enter the ocean. However, if SRB were used, the wastewater would not meet NPDES pollutant discharge limits for pH. Heat and potentially various metals would be a wastewater management constraint for both liquid and solid boosters.

The off-shore launch facilities proposed for 3.5 miles out from Hawaii, Port Hueneme and CCAFS face similar hazardous waste issues as the near-shore launch sites. The flight and range safety limitations and toxic hazards associated with off-shore launches are significantly less than with land or near-shore launches due to their remoteness. Transportation hazards are greater since the launch vehicle requires transportation while loaded with fuels over more distance than any of the other options.

Rockwell

Rockwell recovery configurations consist of flyback boosters and recovery of the P/A module on land via parachute. No liquid booster P/A modules are proposed for recovery. The flyback boosters are more controllable than landing parachutes on land, and are therefore considered somewhat safer.

Rockwell proposes an option for a Hawaii launch site at Palima Point in addition to land launch sites at VAFB and CCAFS. The health and safety constraints are the same as

discussed under Martin Marietta Corporation/McDonnell Douglas in the following section for a land launch at Palima Point.

United Technologies Corporation

United Technologies Corporation proposed flyback boosters and recovery of P/A modules on land via parachute. The liquid booster P/A modules are not planned for recovery. As discussed for Boeing and Rockwell, the parachute landing has a greater probability of an outer limits landing.

4.0 REGULATORY REQUIREMENTS

4.0 REGULATORY REQUIREMENTS

A variety of federal, state and local regulatory requirements provide potential constraints to the ALS program and will need to be considered as the program moves forward. Representative regulations and regulatory requirements are outlined below. They are categorized by federal, state and local jurisdictions.

4.1 FEDERAL REQUIREMENTS (Including Air Force)

National Environmental Policy Act

Rivers and Harbors Act

Clean Waters Act

Marine Mammal Protection Act

Endangered Species Act as amended

Fish and Wildlife Conservation Act

Federal Compliance with Pollution Control Standards (Executive Order 12088)

Protection of Wetlands (Executive Order 11990)

Flood Plain Management (Executive Order 11988)

Marine Protection, Research and Sanctuaries Act

Safe Drinking Water Act

National Ambient Air Quality Standards

Occupational Health and Safety Act

Bald Eagle Act

Migratory Bird Treaty Act

Migratory Bird Conservation Act

Land and Water Conservation Fund

Federal Coastal Zone Management Act

National Historic Preservation Act

Inventory of Cultural Resources (Executive Order 11593)

Comprehensive Environmental Response, Compensation, and Liability Act

Resource Conservation and Recovery Act

Toxic Substances Control Act

Clean Air Act

Hazardous Materials Transportation Act

Federal Hazardous Substances Act

Deepwater Ports Act

Outer Continental Shelf Lands Act

Intervention on the High Seas Act

Ports and Waterways Safety Act

4.2 CALIFORNIA REQUIREMENTS

California Coastal Act

California Ambient Air Quality Standards

Alquist-Priolo Hazardous Zones Act

Porter-Cologne Water Quality Control Act

California Water Code

California Fish and Game Code

Local Coastal Plan (County of Santa Barbara)

California Endangered Species Act as amended

California Native Plant Protection Act

4.3 FLORIDA REQUIREMENTS

Florida Endangered and Threatened Species Act

Endangered and Threatened Species Reward Trust Fund Act

Florida Nongame Wildlife Act

Florida Panther Act

Florida Manatee Sanctuary Act

Marine Turtles Protection Act

Feeding of Alligators and Crocodiles Act

Florida Snook Fishing Act

Preservation of Native Flora of Florida Act

Harvesting of Sea Oats and Sea Grapes Act

Protection of Marine Corals and Sea Fans Act

Protection of Mangrove Communities

Florida Administrative Code (FAC) Rule 17-22 Operation and Construction of Industrial Waste Water Treatment and Disposal System

4.4 HAWAII REGULATIONS

State Land Use Boundary Amendment

Conservation District Use Permit

General Plan Amendment (County of Hawaii)

Change of Zone (County of Hawaii)

Special Management Area Use Permit (County of Hawaii)

Consolidation and Resubdivision (County of Hawaii)

Hawaii Revised Statutes (HRS) Clayton 343 - EIS Requirements

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LIST OF ABBREVIATIONS

AFSC	Air Force Systems Command
AFY	acre feet per second
ALS	Advanced Launch System
APPO	Air Pollution Project Office (Hawaii)
BACT	best available contract technology
BCP	base comprehensive process
CCAFS	Cape Canaveral Air Force Station
CFR	Code of Federal Regulations
CFS	cubic feet per second
CIF	cargo integration facility
CWA	Clean Water Act
DAB	Defense Acquisition Board
DOD	Department of Defense
DWR	Department of Water Resources (California)
EA	Environmental Assessment
ETR	Eastern Test Range
FDER	Florida Department of Environmental Resources
GD	General Dynamics
GEO	geosynchronous earth orbit
HCl	hydrogen chloride
HRA	health risk assessment
ITL	integrate, transfer and launch
KSC	Kennedy Space Center
LB	liquid booster
LCH_4	liquid methane
LC	launch complex
LEO	low earth orbit
LH_2	liquid hydrogen
LO_2	liquid oxygen
LRP-1	kerosene
MGD	million gallons per day
MINWR	Merritt Island National Wildlife Refuge
MLP	mobile launch platform
MMC/MD	Martin Marietta Corporation/McDonnell Douglas
MSAP	Major Systems Acquisition Process
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NPS	National Park Service
NSR	New Source Review
O_3	ozone
OFW	Outstanding Florida Waters
P/A	propulsion and avionics
PAM	payload avionics module
pH	hydrogen ion concentration (measure of acidity)

PPM	parts per million
PSD	prevention of significant deterioration
RCRA	Resource Conservation and Recovery Act
SBCAPCD	Santa Barbara County Air Pollution Control District
SDIO	Strategic Defense Initiative Organization
SLC	space launch complex
SO_2	sulphur dioxide
SRB	solid propellant rocket booster
STS	Space Transportation System
TDS	total dissolvable solids
U.S.	United States
USAF	U.S. Air Force
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Service
UTC	United Technologies Corporation
VAFB	Vandenberg Air Force Base
VCAPCO	Ventura County Air Pollution Control District
VIF	vehicle integration facility
WTR	Western Test Range

APPENDICES

APPENDIX 1. AIR QUALITY STANDARDS

Table A1. NATIONAL AND CALIFORNIA AMBIENT AIR QUALITY STANDARDS[a]

Pollutant	Averaging Time	California Standards	National Standards[b] Primary[d,e]	Secondary[d,f]
Oxidant (Ozone)	1-hour	0.10 ppm (200 ug/m^3)	140 ug/m^3 (0.12 ppm)	Same
Carbon Monoxide	8-hour	9 ppm (10 ug/m^3)	10mg/m^3 (9 ppm)	Same
	1-hour	20 ppm (23 mg/m^3)	40 ug/m^3) (35 ppm)	Same
Nitrogen Dioxide	Annual average		100 ug/m^3	Same
	1-hour	0.25 ppm (470 ug/m^3)		
Sulfur Dioxide	Annual average		80 ug/m^3 (0.03 ppm)	
	24-hour	0.05 ppm[g] (131 ug/m^3)	365 ug/m^3 (0.14 ppm)	
	3-hour		none	1,300 ug/m^3 (0.5 ppm)
	1-hour	0.25 ppm (655 ug/m^3)	none	none
Susp. Partic. Matter	Annual geometric mean		75 ug/m^3	60 ug/m^3
	24-hour	100 ug/m^3 [h]	260 ug/m^3	150 ug/m^3
PM_{10}	Annual	30 ug/m^3		
	24-hour	50 ug/m^3		
Sulfates	24-hour	25 ug/m^3		
Lead	30-day	1.5 ug/m^3		
	Quarterly		1.5 ug/m^3	Same
Hydrogen Sulfide	1-hour	0.03 ppm (42 ug/m^3)		
Vinyl Chloride	24-hour	0.010 ppm (26 ug/m^3)		
Visibil.	1 observation	In sufficient amount to reduce the prevailing visibility[i] to less than 10 miles when the relative humidity is less than 70%.		

NATIONAL AND CALIFORNIA AMBIENT AIR QUALITY STANDARDS

Notes:

a. Standards from California Air Resources Board.

b. National standards, other than those based on annual averages or annual geometric means are not to be exceeded more than once per year.

c. California standards are values that are not to be equaled or exceeded with the exception of the CO standards, PM_{10} standards, and 1-hour SO_2 standard which are not to be exceeded only.

d. Concentration expressed first in units which standard was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 mm of Hg (1,013.2 millibars); ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

e. National Primary Standards express the level of air quality necessary to protect the public health from any known or anticipated adverse effects of a pollutant, allowing for a margin of safety to protect sensitive members of the population.

f. National Secondary Standards express the level of air quality necessary to protect the public welfare by preventing injury to agricultural crops and livestock, deterioration of materials and property, and adverse impacts on the environment.

g. (UV fluorescence) In presence of oxidant in excess of state 1-hour standard or in presence of particulates in excess of state 24-hour standard.

h. The 24-hour TSP standard is only applicable to California 24-hour SO_4 combination standard (see Footnote g). CARB recently adopted fine particulate matter (less than 10 microns) standards of 30 ug/m^3 (annual geometric mean) and 60 ug/m^3 (24-hour average).

i. Prevailing visibility is defined as the greatest visibility which is attained or surpassed around at least half of the horizon circle, but not necessarily in continuous sectors.

APPENDIX 2. BIOLOGICAL RESOURCES

Table A2-1. BIOLOGICAL RESOURCES THAT MAY BE CONSTRAINING AT VANDENBERG AFB

Resource	Constraint	Location
Endangered Species		
California Least Tern	H	Breeds in coastal sand dunes April-August at San Antonio Creek, Purisma Point, Santa Ynez Rvier; staging area at mouth of Santa Ynez River in fall.
California brown pelican	H	Breeds on Anacapa Island in winter; roosts at San Antonio Creek, Purisa Point, Santa Ynez River mouth, boathouse breakwater; forages over coastal waters.
American peregrine falcon	H	Transient visitor on VAFB; pair present at Jalama.
Southern sea otter	H	Near-shore waters south to Point Conception; few along VAFB.
Unarmored threespine stickleback	H	San Antonio Creek and Honda Creek.
Guadalupe fur seal	H	Summer visitor to San Miguel Island.
Gray whale	H	Migrates through near-shore waters winter and spring.
Candidate species		
Many plants and animals	M	Refer to maps and tables in URS 1986, USAF 1987.
Ecologically-important habitats		
Wetlands	H	Santa Ynez River marsh and estuary, all streams and ponds.
Coastal dunes	H	Coastal to 1 mile inland Point Pedernales to Surf; south of Purisma Point to Shuman Creek and inland 1 to 4 miles.

Table A2-1. BIOLOGICAL RESOURCES THAT MAY BE CONSTRAINING AT VANDENBERG AFB (Continued)

Resource	Constraint	Location
Burton Mesa chaparral	M	On Burton Mesa and east-central VAFB.
Riparian and oak woodlands	M	Riparian associated wtih most streams; oak woodlands in numerous areas (not mapped).
Bishop pine and tanbark oak forest	H	Tanbark oak on Tranquillon Peak; Bishop pine in 2 locations north of Honda Creek and 2 in east-central VAFB.
Marine mammal haulouts and rookeries	H	Coastal sites Purisma Point, Point Arguello, Rocky Point, Sudden Ranch, Point Conception, Government Cove, and Hollister Ranch; many sites on islands with extensive breeding.
Seabird nest sites	M	Mainland; Point Pedernales, Destroyer Rock, Point Arguello, Rocky Point, Point Conception - 5 species total; nesting on all islands - 12 species total.
Monarch butterfly winter roosts	M	On south VAFB, 65 locations near coast including 1 at boathoust.
Channel Islands National Marine Sanctuary and State ASBS	H	Sanctuary extends 6 miles around the islands; ASBS is for land of islands.
Coastal bluff scrub	M	Coastal bluffs.
Rocky reefs	M	Along much of coastline and scattered off-shore into deeper water on continental shelf.

Table A2-1. BIOLOGICAL RESOURCES THAT MAY BE CONSTRAINING AT VANDENBERG AFB (Continued)

Resource	Constraint	Location
Kelp beds	M	Around islands and along coast with rocky substrate.
Other		
Commercial fishing	H	All types of fishing; important trawling grounds beyond 3-mile limit and set gear grounds nearshore.
Mariculture	M	At all islands and at Point Conception.

Notes: H = high
M = moderate

Table A2-2. SENSITIVE BIOLOGICAL RESOURCES EAST COAST - FAUNA(1)

SCIENTIFIC NAME	COMMON NAME	DESIGNATED STATUS USFWS	CITES	FGFWFC	FCREPA
FISH					
Centropomus undecimalis	Common snook			SSC	
Fundulus jenkinsi	Saltmarsh topminnow			SSC	
REPTILES AND AMPHIBIANS					
*Alligator mississippiensis	American alligator	T(S/A)	II	SSC	SSC
*Caretta caretta caretta	Atlantic loggerhead turtle	T	I	T	T
*Chelonia mydas mydas	Atlantic green turtle	E	I	E	E
Dermochelys coriacea	Leatherback turtle	E	I	E	R
*Dymarchon corais couperi	Eastern indigo snake	T		T	SSC
*Gopherus polyphemus	Gopher tortoise	UR	II	SSC	T
Eretmochelys imbricata imbricata	Atlantic hawksbill turtle	E	I	E	E
*Lepidochelys kempi	Atlantic Ridley turtle	E	I	E	E
Macroclemys temmincki	Alligator snapping turtle	UR			
*Nerodia fasciata taeniata	Atlantic salt marsh water snake	T		T	E
Pituophis melanoleucus mugitus	Florida pine snake	UR		SSC	
Rana areolata	Gopher frog	UR		SSC	
Sceloporus woodii	Florida scrub lizard				R

Table A2-2. SENSITIVE BIOLOGICAL RESOURCES EAST COAST - FAUNA(1) (Continued)

SCIENTIFIC NAME	COMMON NAME	DESIGNATED STATUS USFWS	CITES	FGFWFC	FCREPA
BIRDS					
Accipiter cooperii	Cooper's hawk				SSC
Aimophila aestivalis	Bachman's sparrow	UR			
Ajaia ajaja	Roseate spoonbill			SSC	R
*Ammospiza maritima nigriscens	Dusky seaside sparrow	E		E	E
*Aphelocoma coerulescens coerulescens	Florida scrub jay	UR		T	T
Aramus guarauna	Limpkin			SSC	SSC
Athene cunicularia	Burrowing owl			SSC	SSC
Buteo swainsoni	Swainson's hawk	UR			
Casmerodius albus	Great egret				SSC
Charadrius melodus	Piping plover	T		T	SSC
Circus cyaneus	American harrier or Marsh hawk		II		
Dendroica discolor paludicola	Florida prairie warbler				SSC
Egretta caerulea	Little blue heron			SSC	SSC
Egretta rufescens	Reddish egret	UR		SSC	R
Egretta thula	Snowy egret			SSC	SSC
Egretta tricolor	Tricolored heron or Louisiana heron			SSC	SSC
Elanoides forficatus	Swallow-tailed kite	UR			
Eudocimus albus	White ibis				SSC

Table A2-2. SENSITIVE BIOLOGICAL RESOURCES EAST COAST - FAUNA(1) (Continued)

SCIENTIFIC NAME	COMMON NAME	DESIGNATED STATUS USFWS	CITES	FGFWFC	FCREPA
Falco columbarius	Merlin or pigeon hawk		II		SUD
*Falco peregrinus tundrius	Arctic peregrine falcon	T	I	E	E
*Falco sparverius paulus	Southeastern kestrel	UR	II	T	T
Falco sparverius sparverius	Eastern kestrel		II		
*Fregata magnificens rothschildi	Rothchild's magnificent frigate bird				T
Grus canadensis pratensis	Florida sandhill crane		II	T	T
*Haematopus palliatus	American oyster catcher			SSC	T
*Haliaeetus leucocephalus	Bald eagle	E	I	T	T
Helmitheros vermivorus	Worm-eating warbler				SSC
Ixobrychus exilis exilis	Least bittern				SSC
Laterallus jamaicensus	Black rail				SUD
*Mycteria americana	Wood stork	E		E	E
Nyctanassa violacea	Yellow-crowned night heron				SSC
Nycticorax nycticorax	Black-crowned night heron				SSC
*Pandion haliaetus	Osprey		II		T
*Pelecanus occidentalis carolinensis	Eastern brown pelican			SSC	
Picoides borealis	Red-cockaded woodpecker	E		T	E

Table A2-2. SENSITIVE BIOLOGICAL RESOURCES EAST COAST - FAUNA(1) (Continued)

SCIENTIFIC NAME	COMMON NAME	DESIGNATED STATUS USFWS	CITES	FGFWFC	FCREPA
Picoides villosus auduboni	Hairy woodpecker				SSC
Plegadis falcinellus falcinellus	Glossy ibis				SSC
Recurvirostra americana	American avocet				SSC
Rynchops niger	Black skimmer				SSC
Seiurus motacilla	Louisiana waterthrush				R
Setophaga ruticilla ruticilla	American redstart				R
*Sterna antillarum	Least tern			T	T
Sterna caspia	Caspian tern				SSC
*Sterna dougallii	Roseate tern	UR		T	T
Sterna fuscata	Sooty tern				SSC
Sterna maxima	Royal tern				SSC
Sterna sandvicensis	Sandwich tern				SSC
Vireo altiloquus	Black-whiskered vireo				R
MAMMALS					
Felis concolor coryi	Florida panther	E	I	E	E
Lutra canadensis	River otter		II		
Lynx rufus	Bobcat		II		
Mustela frenata peninsulae	Florida weasel				R
Mustela vison lutensis	Florida mink				R

Table A2-2. SENSITIVE BIOLOGICAL RESOURCES EAST COAST - FAUNA(1) (Continued)

SCIENTIFIC NAME	COMMON NAME	DESIGNATED STATUS USFWS	CITES	FGFWFC	FCREPA
Neofiber alleni	Round-tailed muskrat				SSC
*Peromyscus floridanus	Florida mouse	UR		SSC	T
*Trichechus manatus	West Indian manatee	E	I	E	T
Ursus americanus floridanus	Florida black bear	UR		T	T

E = Endangered
R = Rare
T = Threatened
I = Included in Appendix I (of CITES)
II = Included in Appendix II (of CITES)
UR = Under review (for possible listing)
SSC = Species of special concern
SUD = Status undetermined
T(S/A) = Threatened due to similarity of appearance
USFWS = United States Fish and Wildlife Service: List of Endangered and Threatened Wildlife and Plants, 50 CFR 17.11-12 (official United States List)
CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora
FGFWFC = Florida Game and Fresh Water Fish Commission: Section 39-27, 03-05, FAC (official State of Florida animal list)
FCREPA = Florida Committee on Rare and Endangered Plants and Animals

* Listed in KSC Final Environmental Impact Statement (1979)

(1)Source: Breininger et al, 1984.

Table A2-3. SENSITIVE BIOLOGICAL RESOURCES EAST COAST - FLORA(1)

Scientific Name	Common Name	DESIGNATED STATUS USFS	SITES	FDA	FCREPA	FNAI
Acrostichum danaeifolium	Giant leather fern		T			
Amyris balsamifera	Balsam torchwood					SP
*Asclepias curtissii	Curtis milkweed			T	T	SP
Asplenium platyneuron	Ebony spleenwort			T		
*Avicennia germinans	Black mangrove				SP	
Azolla caroliniana	Mosquito fern			T		
Calamovilfa curtissii	Curtis reedgrass	UR				SP
Calopogon tuberosus	Grass pink (unnamed)		II	T		
Cereus eriophorus var. fragrans	Fragrant wool-bearing cereus	E	II	E		SP
Cereus gracilis	West Coast Prickly-apple	UR	II	E	T	SP
*Chrysophyllum olivaeforme	Satinleaf			E		
Cocos nucifera	Coconut palm			T		
Conradina grandiflora	Large-flowered rosemary	UR				SP
Dichromena floridensis	Florida white-top sedge					SP
Dryopteris ludoviciana	Florida shield fern			T		
Encyclia tampensis	Butterfly orchid		II	T		
Eulophia alta	Wild coco		II	T		
Habenaria odontopetala	Rein orchid (unnamed)		II	T		

Table A2-3. SENSITIVE BIOLOGICAL RESOURCES EAST COAST - FLORA(1) (Continued)

Scientific Name	Common Name	DESIGNATED STATUS USFS	SITES	FDA	FCREPA	FNAI
Habenaria repens	Water spider orchid or creeping orchid		II	T		
Harrisella porrecta	Orchid (unnamed)		II	T		
Hexalectris spicata	Crested coralroot		II	T		
Hymenocallis latifolia	Broad-leaved spider lily	UR				SP
Ilex ambigua	Carolina holly or sand holly			T		
Lechea cernua	Nodding pinweed	UR				SP
Lycopodium alopecuroides	Foxtail club moss			T		
Lycopodium appressum	Southern club moss			T		
Lycopodium carolinianum	Slender club moss			T		
Malaxis spicata	Florida malaxis		II	T		
Nephrolepis biserrata	Boston fern (unnamed)			T		
*Ophioglossum palmatum	Adder's tongue fern (unnamed)	UR		E	E	SP
Ophioglossum petiolatum	Adder's tongue fern (unnamed)			T		
Opuntia compressa	Prickly pear cactus (unnamed)		II	T		
Opuntia stricta	Prickly pear cactus (unnamed)		II	T		
Osmunda regalis var. spectabilis	Royal fern			C		
Peperomia humilis	Pepper (unnamed)			E		
*Peperomia obtusifolia	Florida peperomia			E		

Table A2-3. SENSITIVE BIOLOGICAL RESOURCES EAST COAST - FLORA[1] (Continued)

Scientific Name	Common Name	DESIGNATED STATUS USFS	SITES	FDA	FCREPA	FNAI
Pereskia aculeata	Lemon vine		II	T		
Persea borbonia var. humilis	Dwarf redbay or redbay persea	UR				SP
Phlebodium aureum	Golden polypody			T		
Pogonia ophioglossoides	Rose pogonia		II	T		
Ponthieva racemosa	Shadow witch		II	T		
Psilotum nudum	Whisk fern or fork fern			T		
*Rhizophora mangle	Red mangrove				SP	
Rhynchosia cinerea	Brown-haired snoutbean	UR				SP
Salvinia rotundifolia	Water spangles			T		
Scaevola plumieri	Scaevola			T		SP
Selaginella arenicola	Sand spikemoss			T		
Sophora tomentosa	Necklace pod					SP
Spiranthes laciniata	Lace-lip ladies'-tresses or lace-lip spiral orchid		II	T		
Suriana maritima	Bay cedar			T		SP
Thelypteris interrupta	Aspidium fern (unnamed)			T		
Thelypteris palustris	Marsh fern			T		
Thelypteris quadrangularis	Aspidium fern (unnamed)			T		
Tillandsia simulata	Wild pine or air plant (unnamed)			T		

Table A2-3. SENSITIVE BIOLOGICAL RESOURCES EAST COAST - FLORA(1) (Continued)

Scientific Name	Common Name	DESIGNATED STATUS USFS	SITES	FDA	FCREPA	FNAI
*Tournefortia gnaphalodes	Sea lavender				T	SP
Verbena maritima	Coastal vervain	UR				SP
Verbena tampensis	Tampa vervain	UR				SP
Vittaria lineata	Shoestring fern			T		
Woodwardia aerolata	Netted chain fern			T		
*Zamia umbrosa	East coast coontie		II	C	T	
Zeuxine strateumatica	Orchid (unnamed)		II			

E = Endangered
T = Threatened
C = Commercially exploited
I = Included in Appendix I (of CITES)
II = Included in Appendix II (of CITES)
NT = Non-valid Taxon (ineligible for federal listing)
UR = Under review (for possible listing)
SP = Special concern
USFWS = United States Fish and Wildlife Service: List of Endangered and Threatened Wildlife and Plants, 50 CFR 17.12 (official United States list)
CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora
FDA = Florida Department of Agriculture and Consumer Services: Preservation of Native Flora of Florida Act, Section 581.185, Florida Statutes (official State of Florida list)
FCREPA = Florida Committee on Rare and Endangered Plants and Animals
FNAI = Florida Natural Areas Inventory: List of Special Plants

* Listed in KSC Final Environmental Impact Statement (1979)

(1)Source: Breininger et al, 1984.

Table A2-4. BIOLOGICAL RESOURCES THAT MAY BE CONSTRAINING AT HAWAII

Resource	Constraint	Location
Endangered species		
Hawaiian hoary bat	H	Lowland forests on Hawaii
Humpback whale	H	Present in winter; concentrates in water less than 600 feet deep; common off South Point
Fin, blue, and sperm whales	H	Uncommon.
Green sea turtle	H	Off-shore waters.
Leatherback sea turtle	H	Off-shore waters.
Hawksbill sea turtle	H	Nests on sandy beaches of Hawaii.
Hawaii akepa	H	Windward forests.
Akiapola'au	H	Forests on Kona Coast, Mauna Loa, and Mauna Kea.
Hawaii creeper	H	Windward forests and Kua Forests.
O'u	H	Windward forests.
Pali la	H	Mamane-naio forest on Mauna KEa above 6,000 feet.
Hawaiian coot	H	Fresh and brackish wetlands near coast.
Hawaiian duck	H	Wetlands, ponds, streams.
Hawaiian goose	H	Northeast side of Mauna Loa.
Hawaiian stilt	H	Leeward forest of Kona area.
Hawaiian crow	H	Windward and leeward forests of Mauna Loa, Mauna Kea, and Kohala Mountains.
Hawaiian dark-rumped petrel	H	Breeds at high elevation on southwest rift of Mauna Loa.
Newell's Townsend's shearwater	H	Breeds in forested slopes.
Hawaiian owl	M	Forest and grassland.
Plants (4 species)	H	
Candidate species		
Many species and plants	M	
Ecologically important habitats		
Wetlands	H	Hoonoua wetland near Kamilo Point, and at Punalu'u Beach.
Coral reefs	M	Along coast.
Seabird nesting (3 to 4 species)	M	On mountains.
Hawaii Volcanoes National Park	H	

Table A2-4. BIOLOGICAL RESOURCES THAT MAY BE CONSTRAINING AT HAWAII (Continued)

Resource	Constraint	Location
Other		
Commercial fishing.	?	?

Notes: H = high
M = moderate
? = unknown